2021

MODIS-N

WORK BREAKDOWN STRUCTURE DICTIONARY

(Level-4 Cost Accounts noted for reference.)

PRELIMINARY

WORK BREAKDOWN STRUCTURE (WBS) DICTIONARY
Moderate Resolution Imaging Spectrometer, Nadir (MODIS-N)

0XXX SYSTEM STUDY

This element includes efforts required to refine derived requirements on the instrument system and subsystems, to conduct tradeoffs and refine the instrument design, and to prepare and present the System Study Review. It includes the initial effort to plan the MODIS-N program and initiate the Performance Measurement System (PMS) and the training associated with the preparation for the implementation of the PMS.

00XX System Study

000X Program Office

This element includes efforts required to provide program management activities for the System Study. Hi-Rel parts support for the study is included. The program office will supply fiscal, technical, and schedule direction to the Program Team.

001X Business Management

This element includes business system development and maintenance and program office support during the System Study. A primary focus is the development of the integrated cost/schedule control system (the Performance Measurement System (PMS)), for the program.

002X System Engineering

This element includes the system engineering and analysis effort required to generate and refine overall system requirements during the System Study, including the instrument and test equipment. It includes training, planning, and support for the implementation of the PMS.

003X Configuration and Data Management

This element includes the hardware configuration management, software configuration management, and data management support effort required during the System Study. It includes training, planning, and scheduling support for the implementation of the PMS.

004X Mechanics

This element includes the mechanical engineering effort required to refine the instrument design and development during the System Study. It includes training, planning, and scheduling support for the implementation of the PMS.

005X Optics

This element includes the optical effort required to refine the instrument design and development during the System Study. It includes training, planning, and scheduling support for the implementation of the PMS.

006X Electronics

This element includes the electronics and flight software engineering effort required to refine the instrument design and development during the System Study. It includes training, planning, and scheduling support for the implementation of the PMS.

007X Not Used

008X Focal Planes

This element includes the focal plane engineering effort required to refine the instrument design and development during the System Study. It includes training, planning, and scheduling support for the implementation of the PMS.

009X Not Used

00AX Ground Support Equipment
This element includes the GSE subsystem engineering and GSE software engineering effort required to support the instrument design and development during the System Study. It includes training, planning, and scheduling support for the implementation of the PMS.

00BX Manufacturing
This elements includes the Manufacturing effort during the period prior to SSR associated with Performance Measurement System training, Microsoft Project training, responding to program office requests, establishing budgets and manpower requirements, reviewing need for P.I.s, reviewing MPA and PC/MC roles to eliminate duplication of effort, review Manufacturing's role in design activity, coordinate quality issues of the Product Assurance Requirements document with Product Assurance.

00CX Quality Assurance
This element includes the quality assurance effort required to support the instrument design and development during the System Study. MODIS-N unique quality systems and procedures will be developed. It includes training, planning, and scheduling support for the implementation of the PMS.

00DX Reliability
This element includes the Reliability effort required to support the instrument design and development during the System Study. It includes training, planning, and scheduling support for the implementation of the PMS.

00EX Not Used

00FX Hughes Technology Center (HTC)
This element includes the IR Readout and VIS and NIR Focal plane design support to the Focal Plane Project Manager required to refine the instrument design and development plans during the System Study.

00GX Electron Dynamics Division (EDD)
This element includes the Power Supply design support to the Electronics Project Manager required to refine the instrument design and development plans during the System Study.

00HX Electronics Packaging
This element includes the electronics packaging effort required to refine the instrument design and development during the System Study. It includes training, planning, and scheduling support for the implementation of the PMS.

00PX Company Operations

1XXX PROGRAM MANAGEMENT

This element includes all efforts required to provide program management. It includes planning, technical direction, schedules, budgets, formal and informal reviews, documentation, and control of all program efforts including program management functions for the major subcontractors.

11XX Program Office

This element includes program technical integration and management: to direct performing functional groups, management/integration of customer interface, and liaison meetings. It specifically includes the efforts of the program manager's staff, and contract administrative support. This element includes the preparation and maintenance of a project plan, a Project Organization Chart, and other program management CDRL items

not separately priced and included in 140X. This element includes the effort, if required, to prepare estimates for added scope tasks.

This element includes the management of major subcontractors. It covers planning, technical direction, schedules, budgets, integration, measurement, and control of all program effort associated with major subcontractors. It coordinates government approval of major subcontracts. This task includes subcontract administration (procurement) specifically assigned to support any major subcontract technical officers. Engineering assigned to the subcontract should be covered in the appropriate WBS element where the subcontract appears. Material Procurement Administration (MPA) is included in this WBS element.

This element includes all efforts associated with the procurement of high reliability parts and materials which are generally not specifically designed by the SBRC for M0DIS-N.

110X Program Office

This cost account includes all program management (program manager and associate program manager) for the period from SSR to delivery of Flight Model 2. Clerical support within the program for the same duration is included. This cost account includes the effort, if required, to prepare estimates for added scope tasks. The Subcontracts liaison representing the Materiel Directorate and the Hi-Rel Electronics Parts Manager are also included. Material Procurement Administration (MPA) is included in this cost account. Labor costs for participation in and travel costs for personnel involved in reviews are included. Preparation and reproduction costs for review data packages are covered elsewhere in the WBS. This cost account includes the preparation of the following CDRL items: 004 (Detailed Schedules), 006 (Performance Assurance Implementation Plan), 403 (DPA Procedures), 505 (Nonstandard Parts Data Packages), 521 (Weekly Status Reports), 527 (As-Designed Parts List, 528 (As-Built parts List), 529 (Reports of Work), 531 (DOD Industrial Plan Equipment Requisition (DD Form 1419)), 533 (Annual Report of Government-owned/Contractor-held Property), 535 (Subcontracting Reports for Individual Contracts (Standard Form 294)), 536 (Summary Subcontracting Report (Standard Form 295), and 537 (Report on NASA subcontracts (NASA 667).

- *The cost associated with the MPA should be move from 15XX to 110X.*

12XX Financial and Schedule Controls and Reporting

This element includes all effort to develop and maintain a program control section, prepare and maintain a master program schedule, prepare and maintain schedules and reporting in conformance with - the Performance Measurement System. This task does not include the efforts of technical and functional management to prepare, analyze and control their internal schedules or their contribution to the maintenance of program schedules and status. These efforts are considered to be a part of tasks defined elsewhere in the WBS.

This element also includes integration, preparation, and maintenance of program budgets and the assessment of progress against them, including reporting in conformance with the Performance Measurement System. It also includes financial evaluation of changes on the program; the preparation of management and customer financial reports (except for CDRL 534 (Monthly and Quarterly Financial Management Reports that are priced

separately in 141X)); and implementation of cost control procedures. It includes CDRL items 003 (Performance Measurement System Implementation Plan & System Description - completed with the proposal), 015 (Updated WBS Diagram and Task Description) and 523 (Performance Measurement Status Report (PMSR).

121X Business Management
Same as 12XX.

13XX Configuration Management and Data Management

This element includes configuration control to the component level for hardware, and to the line of code level for software. It includes the preparation and maintenance of a Hardware System Configuration Management Plan (CDRL 005) and the preparation, maintenance, and control of performance and interface requirements and other related documentation. It includes the preparation and maintenance of a Software System Configuration Management Plan (part of CDRL 008) and the preparation, maintenance, and control of software requirements and other related documentation. This element includes the effort to administer the tracking, compilation, reproduction, and submittal (through Contracts) of CDRL items 104 (Engineering Analysis Reports), 105 Contractor-Generated Internal Technical Memoranda, 203 (Configuration Management Status Report), 220 (Other Technical Reports and Reissued Reports), 304 Engineering Drawings, for Materials Applications), 401 (Standard Practices and Procedures), , 509 (Approved or Controlled Drawings), 510 (Material Review Board Waiver/Deviation Requests), 511 (Safety Waiver Requests), 512 (Configuration Change Requests (CCR) Class I), 513 (Configuration Change Requests (CCR) Class II), 517 (Drawing Books), and 518 (Indentured Drawing List). It includes status accounting and verification auditing. This element includes the effort to administer the tracking, reproduction, and submittal (through Contracts) of the data items prepared under element 14XX.

133X CDMO
Same as 13XX.

14XX Documentation

This element includes he preparation and maintenance of the overall MODIS-N program documentation as specified in the contract. This item includes the effort to organize and outline any documentation preparatory to its generation. All documentation included in this item shall be individually identified (e.g.,Design Report, Interface Specification Document, Operation and Maintenance Manuals, etc.). The effort to administer the tracking, reproduction, and submittal (through Contracts) of these data items is included in element 13XX of this WBS.

140X Program Office
This cost account includes those activities and costs associated with preparation and organization of CDRL documents prepared by the Program Office. It includes Tech Pubs costs for the preparation of the review packages for the SSR (CDRL 014), PDR (CDRL 016), SWPDR (CDRL 017), CDR (CDRL 020), and SWCDR (021). (Note that CDRL 001 (Management Plan) CDRL 002 (Project Organization Chart), and CDRL 012 (Small Business & Small Disadvantaged Business concerns Subcontracting Plan) were completed with the proposal). Other CDRL items included in this cost account are 204 (Performance Assurance Status Report) and 522 (Photographic Records).

141X Business Management

This cost account includes those activities and costs associated with preparation and organization of separately priced CDRL documents prepared by Business Management. It includes CDRL item 534 (Monthly & Quarterly Financial Management Reports (NASA Form 533M/533Q) and the following items to be added to the CDRL list: Schedule Management Plan, Level 1 Master Schedule, Intermediate Logic Network Diagrams, Intermediate Bar Charts, Tabular Reports, 60 Day Window Report,Work Packages/Scheduling System Cross Reference Guide, End Item Float Report, and Monthly Analysis (Reference: Metcalf letter to Dawson dated August 19, 1991).

142X System Engineering

This cost account includes those activities and costs associated with preparation and organization of CDRL documents prepared by or directed by System Engineering. It includes CDRL items 007 (Contamination Control Plan), 018 (Calibration Management Plan), 025 (In-Flight Checkout Plan), 027 (EM Test Review Data Package), 029 (Pre-Environmental Review (PRER) Data Package, 030 (Post-Environmental Review (POER) Data Package, 031 (Pre-Storage Review Data Package), 032 (Pre-Ship Review (PSR) Data Package), 101 (Radiometric Math Model), 208 (Performance Verification Reports), 222 (Specification Compliance and Calibration Books), 226 (Final Report-Design Through Flight Evaluation), 305 (Engineering Telemetry Description), 307 (Operation and Maintenance Manuals), 404 (Operational In-Flight Calibration Procedures), 405 (General Operating Command Procedures), 516 (Instrument Interface Description Document), and 519 (MODIS-N Technical Description Document).

• *The budget for CDRL 007 is presently in 14BX (was 18B3).*

14AX Ground Support Equipment

This cost account includes those activities and costs associated with preparation and organization of CDRL documents prepared by or directed by the Ground Support Equipment organization. It includes CDRL items 008 (Software Management Plan), 009 (Sustaining Engineering and Operations Plan), 026 (Software Test Readiness Review (SWTRR) Data Package), 028 (Software Acceptance Review (SWAR) Data Package), 033 (Software Test Plan), 217 (Software Test Reports), 306 (Software Product Specifications), 309 (Software Assurance Specifications), 402 (Software Standards and Procedures), 415 (Software Test Procedures), and 514 (Software Discrepancy Reports). CDRL item 508 (Procurement Document) is included in 92AX.

• *CDRL items 017 (Software Preliminary Design Review (SWPDR) Data Package) and 021 (Software Critical Design Review (SWCDR) Data Package are included in 140X.*

14BX Manufacturing

This cost account includes the generation of documentation to satisfy CDRL items 010 (Make or Buy Plan-completed with Proposal), 023 (Fabrication and Assembly Flow Plan), 035 (Spares Program Plan), 202 (Data on Uncured, Out-of-Date Materials), 406 (Transportation and Handling Procedures), 413 (Assembly Procedures),, 522 (Photographic Records) and 525 (As-Built Materials List). This effort may be by the manufacturing manager, manufacturing engineering, production control or others to support the CDRL tasks.

• *CDRL item 414 (Standard Repair Procedures) is in 15XX. CDRL 012 (Small Business and Small Disadvantaged Business Concerns Subcontracting Plan)was completed prior to contract award, and 007 (Contamination Control Plan) was moved to 142X.*

14DX Reliability

This cost account includes those activities and costs associated with preparation and organization of CDRL documents prepared by or directed by Reliability. It includes CDRL items 013 (Safety and Health Plan - completed at time of contract award), 034 (Launch Site Safety Plan), 106 (Hazard Analysis), 107 (Operations Hazards Analysis), 108 (Failure Modes and Effects Analysis (FMEA)), 109 (Parts and Devices Stress Analysis), 110 (Reliability Assessment), 111 (Trend Analyses (List of Parameters to be Monitored), 112 (Worst Case Analysis), 209 (Multifunction/Failure Reports), 211 (Problem and Failure Report Close-Out), 215 (Trend Analysis Reports (Monitoring Selected Parameters)), 216 (Hazard Control Verification Report), 224 (Safety Compliance Data Package), 504 (Limited Life Items List), 505 (Non-Standard Parts Data Packages), 506 (Materials Lists, Lubrication List, and Processes Lists), and 524 (Material Usage Agreement/Stress Corrosion Evaluation).

14EX System Test

This cost account includes those activities and costs associated with preparation and organization of CDRL documents prepared by or directed by the System Integration and Test organization. It includes CDRL items: 024 (Storage and Storage Testing Plan), 221 (Storage Testing Reports), and 407 (Storage Testing Procedures).

15XX Manufacturing Management

This element includes manufacturing support labor not directly related to a hardware or touch labor task. It includes the efforts of Material Control/Production Control, the Manufacturing Manager (who is the Responsible Manufacturing Authority (RMA)), Material Cost Analysis, and support to the Hi-Rel Parts Manager. The effort to manage all Manufacturing cost accounts is included in this WBS element.

15BX Manufacturing

This element includes manufacturing support labor not directly related to a hardware or touch labor task. The manufacturing effort included in this WBS element include the Manufacturing Manager, Production/Material Control, manufacturing Cost Analysis, and support to the Hi-Rel Parts Manager. It does not, however, include production/material control, manufacturing engineering, or assembly effort in support of the spares activity; these costs are in cost account 7CBX. This cost account includes the preparation of CDRL item 414 (Standard Repair Procedures).

The Manufacturing Manager [Responsible Manufacturing Authority (RMA)] is tasked to provide overall guidance to the functional manufacturing departments for the entire manufacturing effort, including administering the Spares Program (See CDRL 035). The RMA is responsible for direct labor budget distribution to these departments. The RMA will represent all manufacturing activities at program meetings and attend manufacturing status meetings, prepare reports for presentation at program meetings, coordinate and set priorities within manufacturing for the different project tasks, and coordinate support from outside the manufacturing departments as necessary to achieve schedule commitments. The RMA's efforts associated with the statusing and scheduling of all cost accounts managed by the RMA will be included in this cost account.

Production Control/Material Control (PC/MC) support includes the material control efforts of purchase requisition generation and status tracking, report generation, and expediting of material from dock-to-stock. It includes the coordination of shipment of material to support supplier deliveries, and maintenance of purchase requisition

and purchase order files. Production Control's tasks include the preparation and maintenance of master and individual manufacturing schedules based on build and setback schedules provided by manufacturing engineering, moving hardware through assembly and test, tracking the movement of assemblies, and prioritizing the assembly work areas. PC is also involved in change review board, chairs the weekly assembly status meetings, publishes weekly progress schedules, and analyzes and reports on material requirements. Bonded stores will receive/stock incoming materials, pull kits (noting traceability), enter inventory transactions into the S.T.I.C.H. system, and maintain inventory documents. Manufacturing support of the Hi-Rel parts procurement effort will be provided to the Hi-Rel parts procurement manager on a part-time basis. This effort includes preparing purchase requisitions, preparing and executing stock transfers, interfacing with receiving and receiving inspection, and a combination of the standard Production/Material Control functions applied to Hi-Rel parts procurement.

Manufacturing Cost Analysis effort shall be to provide administrative support to the manufacturing department in the area of cost control and PMS support. The effort to manage all Manufacturing cost accounts is included in this cost account. This element includes the effort to develop, maintain, and report project schedules, including preparing, maintaining, and updating of network schedules. It includes preparing, maintaining, and updating schedules necessary to meet the delivery and test requirements specified. This element further includes supporting the Manufacturing Manager to develop, maintain, and report cost information including preparing, maintaining, and updating cost account plans. It includes analyzing monthly financial reports and subsequent preparation of variance analysis reports, if necessary. It includes preparing and reviewing with the Manufacturing Manager any budget change requests.

• *The estimated cost for MPA support should be moved to the 110X cost account.*

1LXX EDCC and Labor Pools

This element includes the allocated costs for Engineering Document Control Center (EDCC) services and labor pooling allocations. EDCC releases and maintains records and files of engineering documents. Labor Pooling charges for managers and secretaries in the labor pool system are automatically allocated across the accounts charged by the personnel that they support.

1LPX Company Operations

Same as 1LXX.

2XXX SYSTEM ENGINEERING AND ANALYSES

This element includes the effort required to generate the overall system requirements, which include the instrument and its test equipment. It includes definition of system requirements and interfaces so that the individual subsystem designs may advance in a unified manner. The system engineering task will include all advisory efforts involved in the design, integration test and evaluation of the M0DIS-N as an individual system and as a part of a spacecraft system. This will he a continuing effort starting with system definition and following through to final performance tests and calibrations. This WBS element includes all system engineering CDRL items not separately priced and included in 142X. These include CDRL items: 011 (New Technology Reporting Plan), 019 Calibration Peer Review (CPR) Data Package), 022

Performance Verification Plan, 102 (Structural Math Model), 103 (Thermal Math Model), 201 (Previously Designed, Fabricated or Flown Hardware Data), 207 (Engineering Test Reports), 218 (Data on Non-Conventional Application of Materials), 219 (Instrument Output Data Records Required in Special Data Requirements Section of the MODIS-N Specification), 221 (Storage Testing Reports), 223 (New Technology Reports), 224 (Safety Compliance Data Package), 225 (Responses to Formal Actions), 301 (Specifications on parts, Materials, Subassemblies/Subsystems), 302 (Instrument Functional logic Diagrams), 303 (Command List and Description), 308 (Performance Verification Specification), 407 (Storage Testing Procedures), 408 (Control of Unscheduled Activities (Integration/Verification Testing)), 409 (Detailed Test Procedures), 410 (Detailed Ground Calibration Procedures), 411 (GSE Test Procedures), 412 (Performance Verification Procedures), 503 (Weight and Power Budgets), and 515 (Drawing Tree).

- *The above listed CDRL items need to be assigned to appropriate cost accounts. CDRLs 014 (System Study Review Data Package), 016 (Preliminary Design Review (PDR) Data Package), and 020 Critical Design Review (PDR) Data Package) were deleted from the System Engineering list since they are included in 140X.*

21XX Administration

This element includes the effort required to support the Program Office in communications with GSFC and SBRC Management regarding the technical status of the MODIS-N program. It includes management of the total system engineering effort and system engineering support provided in preparation of program schedules and implementation of the PMS.

This element includes all System Engineering efforts associated with the preparation, organization, and presentation of all required internal design reviews. It includes all System Engineering efforts associated with the preparation, organization, and presentation of the formal design reviews, including the Quarterly management Review, Preliminary Design Review, the Critical Design Review, Pre-Environmental Testing Reviews, Post-Environmental Testing Reviews, and Preshipment (Acceptance) Reviews. It shall include travel costs, manpower, and all special documentation needed to conduct these formal and informal reviews. The cost of producing and reproducing CDRL items associated with these reviews is included in WBS-element 14XX.

212X System Engineering
Same as 21XX.

22XX Requirements

This element includes all system engineering to define system and subsystem requirements as design inputs for an instrument which will meet the specifications. This element includes system engineering oversight in the definition and control of all internal instrument interfaces.

This element includes definition of all test and calibration requirements to assure that the test and calibration program demonstrates compliance with the specifications. It includes the generation of top-level ground support equipment requirements and test specification requirements which will ensure the verification of the instrument performance requirements. The updating of the Performance Verification Plan (CDRL 022), Calibration Management Plan (CDRL 018), Contamination Control Plan (CDRL 007) and the Storage and Storage Testing Plan (CDRL 024) are included under this element.

This element includes the preparation and updating of system-level instrument test and calibration procedures. It includes the preparation, review and updating of the subsystem procedures to ensure they are compatible with and responsive to the overall system test plans.

This element includes definition of data system requirements from within the instrument to the GSE, via the spacecraft (when present) and EOSDIS (when present). The purpose of the requirements is to assure that the instrument data are available for engineering evaluation when the instrument is at the SBRC facility, at the spacecraft integrator's facility, on an EOS spacecraft at the spacecraft integrator's facility, or in orbit.

222X System Engineering
Same as 22XX.

23XX System Analyses

This element includes all analytical studies carried out as inputs to the design of the instrument, which are necessary to assure that the instrument will satisfy the specifications, or which are required for delivery to the spacecraft contractor.

This element includes systems engineering oversight and participation in engineering analyses of the data resulting from test and calibration of the instrument models. It includes analysis of all performance data to verify compliance with the specifications, or to identify areas where the trade-offs and/or improvements may be necessary.

This element includes generation and maintenance of all radiometric analyses necessary to assure that the instrument will satisfy the specifications, both during ground testing and in orbit. It includes the radiometric math models identified in the specification.

This element includes system engineering oversight of all optical analyses necessary to assure that the instrument will satisfy the specifications.

This element includes system engineering oversight of all polarization analyses necessary to assure that the instrument will satisfy the
specifications.

This element includes system engineering oversight of all stray light analyses necessary to assure that the instrument will satisfy the specifications.)

This element includes system engineering oversight of all electrical/electronic analyses necessary to assure that the instrument will satisfy the specifications.

This element includes generation and maintenance of all structural analyses necessary to assure that the instrument will satisfy the specifications, or to provide to the spacecraft contractor.

This element includes generation and maintenance of all system-level thermal analyses necessary to assure that the instrument will satisfy the specifications, or to provide to the spacecraft contractor. The system thermal analyses include both the instrument assembly

and any radiative coolers. This element includes system engineering oversight of all thermal analyses performed at the component or assembly level.

This element includes generation and maintenance of all contamination analyses necessary to assure that the instrument will satisfy the specifications.

This element includes generation and maintenance of all analyses of the impact of temperature changes upon instrument performance which are necessary to assure that the instrument will satisfy the specifications. It includes thermal sensitivities of the optics, spectral definition, focal plane, structure, mechanisms, and electronics.

232X System Engineering
Same as 23XX.

24XX Spacecraft Interfaces

This element includes specification and control of all interfaces between the instrument and the spacecraft.

242X System Engineering
Same as 24XX.

25XX Instrument Integration and Test Support

This element includes the system engineering support during the integration and test phases of the program to assess, on a day-to-day basis, the validity of the data and test results (both during alignment and test) so as to anticipate and prevent serious problems later on. This element includes preparation and maintenance of the instrument command list and description and general instrument operating procedures.

252X System Engineering
Same as 25XX.

26XX Algorithm Development

This element includes all algorithm development necessary to support instrument testing, calibration and performance evaluation in any instrument operating environment.

262X System Engineering
Same as 26XX.

4XXX INSTRUMENT DESIGN & DEVELOPMENT

This element includes all the design activity, in coordination with the system engineering and system analyses, necessary to assure that the instrument will satisfy the specifications. Interface design activity, pertinent both to interfaces within the instrument and to interfaces between the instrument and the spacecraft, is included within the appropriate elements listed below. These elements shall be performed in coordination with the system engineering and system analyses performed under WBS element 2XXX, to assure that the instrument will satisfy the specifications. This element includes the generation of engineering drawings and other design documents, maintenance of these documents during the design period through Critical Design Review. It includes breadboarding and subsystem design analyses, subsystem project management and subsystem cost and schedule planning and control.

41XX Optical Assemblies and Mounts Design

This element includes all design activity associated with the Afocal Telescope Assembly, and the aft-optics objective assemblies (VIS Objective, NIR Objective, SWIR/MWIR Objective, and LWIR Objective), the dichroic beamsplitters (Dichroic #1, Dichroic #2, and Dichroic #3) and their mounts, and the spectral filters for the VIS, NIR, SWIR/MWIR, and LWIR focal planes. The design of the Optical Bench Housing is included in this element. The design of the filter mounting hardware is included in element 42XX. This element includes interface design activity, pertinent to interfaces between the these optical assemblies and other components of the instrument. It includes the generation of engineering drawings and other design documents for these optical assemblies and mounts, maintenance of these documents during the design period through Critical Design Review. It includes breadboarding, risk reduction activities, and optical design analyses related to these elements of the design. Design analyses include optical ray traces, stray light analyses, polarization analyses, thermal and structural analyses. It includes support of the contamination analyses performed by System Engineering. This element includes the effort to provide Opto-Mech project management for the Design and Development period ending at the Critical Design Review. It includes cost and schedule planning, control, and statusing for 41XX cost accounts for the design and development period ending at the Critical Design Review. This element includes all efforts associated with the preparation organization, and presentation of all required internal design reviews regarding hardware or software items included in this WBS element. It includes all preparation and organization of materials in support of the MODIS-N system Preliminary Design Review and the Critical Design Review. Data package preparation and participation in these formal system-level reviews are included elsewhere in the WBS.

414X Mechanics

This cost account includes all mechanical design activity associated with the Afocal Telescope Assembly, and the aft-optics objective assemblies (VIS Objective, NIR Objective, SWIR/MWIR Objective, and LWIR Objective), the dichroic beamsplitters (Dichroic #1, Dichroic #2, and Dichroic #3) and their mounts. The mechanical design of the Optical Bench Housing is included in this cost account. This cost account includes mechanical, thermal, and structural interface design activity, pertinent to interfaces between the these optical assemblies and other components of the instrument. It includes the generation of engineering drawings and other design documents for the mechanical parts and subassemblies of these optical assemblies and mounts, maintenance of these documents during the design period through Critical Design Review. It includes breadboarding, risk reduction activities, and mechanical, thermal, and structural design analyses related to these elements of the design. It includes support of the contamination analyses performed by System Engineering. This element includes the effort to provide Opto-Mech project management for the Design and Development period ending at the Critical Design Review. It includes cost and schedule planning, control, and statusing for 41XX cost accounts for the design and development period ending at the Critical Design Review. This element includes all efforts associated with the preparation organization, and presentation of all required internal design reviews regarding hardware or software items included in this WBS element. It includes all preparation and organization of mechanical, thermal, and structural design materials in support of the MODIS-N system Preliminary Design Review and the Critical Design Review. Data package preparation and participation in these formal system-level reviews are included elsewhere in the WBS.

415X Optics

This cost account includes all optical design activity associated with the Afocal Telescope Assembly, and the aft-optics objective assemblies (VIS Objective, NIR Objective, SWIR/MWIR Objective, and LWIR Objective), the dichroic beamsplitters (Dichroic #1, Dichroic #2, and Dichroic #3), and the spectral filters for the VIS, NIR, SWIR/MWIR, and LWIR focal plane assemblies. The design of the filter mounting hardware is included in cost account 428X. This element includes optical interface design activity, pertinent to interfaces between the these optical assemblies and other assemblies of the instrument. It includes the generation of engineering drawings and other design documents for the optical parts of these optical assemblies, maintenance of these documents during the design period through Critical Design Review. It includes optical breadboarding, optical risk reduction activities, and optical design analyses related to these elements of the design. Design analyses include optical ray traces, optical sensitivity and tolerance analyses, stray light analyses, and polarization analyses. It includes support of the contamination analyses performed by System Engineering. This cost account includes the efforts of the Optical Cost Account Manager for the Design and Development period ending at the Critical Design Review. It includes cost and schedule planning, control, and statusing for 41XX cost accounts for the design and development period ending at the Critical Design Review. This element includes all efforts associated with the preparation organization, and presentation of all required internal design reviews regarding hardware or software items included in this WBS element. It includes all preparation and organization of materials in support of the MODIS-N system Preliminary Design Review and the Critical Design Review. Data package preparation and participation in these formal system-level reviews are included elsewhere in the WBS.

42XX Focal Plane Assemblies Design

This element includes all focal plane design and breadboard activity, except for the design of the spectral filters which is included in 41XX and the design of the Cold Focal plane Assembly platform, which is included in 45XX. It includes the design of the VIS, NIR, SWIR/MWIR, and LWIR focal planes. It includes the efforts associated with the design, fabrication, and testing of any proof-of-concept parts for design evaluation or life testing of the focal plane assemblies. The Focal Plane design includes the sensor chip assembly (SCA) design, detector design, readout design, mechanical packaging design, and cable and connector design. It includes interface design activity, pertinent to interfaces between the focal planes and other components of the instrument and between the focal plane subassemblies. This element includes the generation of engineering drawings and other design documents for the Focal Planes, maintenance of these documents during the design period through Critical Design Review. It includes breadboarding and risk reduction activities, and Focal Plane design analyses. Design analyses include detector and readout performance analyses, stray light analyses, thermal and structural analyses. It includes support of the contamination analyses performed by System Engineering, and the design and development of focal plane packaging tooling, critical process development, and SCA/FPA test equipment. This element includes the effort to provide Focal Plane project management for the Design and Development period ending at the Critical Design Review. It includes cost and schedule planning, control, and statusing for all 42XX cost accounts for the design and development period ending at the Critical Design Review. It includes the effort associated with interfacing with Hughes Technology Center and coordinating the design and development of the VIS and

NIR sensor chip assemblies and the infrared focal plane readout circuits. This element includes the design and fabrication of a brassboard readout drive electronics assembly for use in SCA testing and as a design aid for interface electronics incorporated in the Analog Electronics Modules (47XX). This element includes all efforts associated with the preparation, organization, and presentation of all required internal design reviews regarding hardware or software items included in this WBS element. It includes all preparation and organization of materials relative to the activities of this WBS element in support of the MODIS-N system Preliminary Design Review and the Critical Design Review. Data package preparation and participation in these formal system-level reviews are included elsewhere in the WBS.

428X Focal Planes

Same as 42XX, excluding the delegated responsibilities for the design of the VIS and NIR sensor chip assemblies (SCAs) and the readout integrated circuits (see 42FX).

42FX HTC

This cost account includes the design of the VIS and NIR sensor chip assemblies and the IR readout integrated circuits (ROICs). This element includes the generation of engineering drawings and other design documents for these assemblies, maintenance of these documents during the design period through Critical Design Review. It includes breadboarding and risk reduction activities, and VIS and NIR sensor chip assemblies and the IR readout integrated circuits design analyses. Design analyses include detector and readout performance analyses. This cost account includes the effort to provide cost account management for the Design and Development period ending at the Critical Design Review. It includes cost and schedule planning, control, and statusing for the 42FX cost account. It includes all preparation and organization of materials relative to the activities of this cost account in support of the MODIS-N system Preliminary Design Review and the Critical Design Review. Data package preparation and participation in these formal system-level reviews are included elsewhere in the WBS.

43XX Mainframe Structure and Door Design

This element includes the design of the mainframe structure and anti-contamination doors. This includes the design of the system aperture, solar calibration, and radiative cooler anti-contamination door assemblies. The design of actuators to control these doors is also included in this element. This element also includes the design of the multi-layer insulation (MLI) thermal blankets. This cost account includes mechanical, thermal, and structural interface design activity, pertinent to interfaces between the Mainframe, doors, and door actuators and other assemblies of the instrument. It includes the generation of engineering drawings and other design documents for the mechanical parts, mechanisms, and subassemblies of the Mainframe Assembly and door assemblies, maintenance of these documents during the design period through Critical Design Review. It includes breadboarding, risk reduction activities, and mechanical, thermal, and structural design analyses related to these elements of the design. It includes support of the contamination analyses performed by System Engineering. This WBS element includes liaison with vendors and coordination with Materiel during the design and development period. It includes cost and schedule planning, control, and statusing for all 43XX cost accounts for the design and development period ending at the Critical Design Review. This element includes all efforts associated with the preparation, organization, and presentation of all required internal design reviews regarding hardware or software items included in this WBS element. It includes all preparation and organization of materials relative to the activities of this WBS element in support of the

MODIS-N system Preliminary Design Review and the Critical Design Review. Data package preparation and participation in these formal system-level reviews are included elsewhere in the WBS.

434X Mechanics

Same as 43XX.

44XX Scan Mirror Assembly Design

This element includes all design and breadboard activity associated with the scan mirror subsystem, except for the control electronics which are included in element 46XX. This element includes the design of the two-sided scan mirror, low distortion mirror mount, and the scan mirror and coatings, and the motor mount assembly. It includes the generation of engineering drawings and other design documents for the optical and mechanical parts, mechanisms, and subassemblies of the Scan Mirror Assembly, maintenance of these documents during the design period through Critical Design Review. This element includes all breadboarding, risk reduction activities, and optical design, thermal, and structural design analyses related to the scan mirror design. It includes support of the contamination analyses performed by System Engineering. This WBS element includes liaison with vendors and coordination with Materiel during the design and development period. It includes cost and schedule planning, control, and statusing for all 44XX cost accounts for the design and development period ending at the Critical Design Review. This element includes all efforts associated with the preparation, organization, and presentation of all required internal design reviews regarding hardware or software items included in this WBS element. It includes all preparation and organization of materials relative to the activities of this WBS element in support of the MODIS-N system Preliminary Design Review and the Critical Design Review. Data package preparation and participation in these formal system-level reviews are included elsewhere in the WBS.

444X Mechanics

Same as 44XX.

45XX Radiative Cooler Design

This element includes all design and breadboard activity associated with the Radiative Cooler. It does not include the radiative cooler anti-contamination door assembly which is included in WBS element 43XX. This element includes all structural and thermal analyses of the Radiative Cooler at the assembly level and below. It includes support of the contamination analyses performed by System Engineering. It includes the generation of engineering drawings and other design documents for the Radiative Cooler Assembly and maintenance of these documents during the design period through Critical Design Review. This WBS element includes liaison with vendors and coordination with Materiel during the design and development period. It includes cost and schedule planning, control, and statusing for all 45XX cost accounts for the design and development period ending at the Critical Design Review. This element includes all efforts associated with the preparation, organization, and presentation of all required internal design reviews regarding hardware or software items included in this WBS element. It includes all preparation and organization of materials relative to the activities of this WBS element in support of the MODIS-N system Preliminary Design Review and the Critical Design Review. Data package preparation and participation in these formal system-level reviews are included elsewhere in the WBS.

454X Mechanics

Same as 45XX.

46XX Main Electronics Module Design

This element includes all design of the Main Electronics Module (MEM), including electronics circuit design and electronics packaging design. This element includes the design and mockup of any harnesses that may be necessary to interconnect the Main Electronics Module with the Analog Electronics Modules, the On-Board Calibrators, and other elements of the electrical subsystem. It includes the efforts associated with the design, fabrication, and testing of any proof-of-concept parts for design evaluation or life testing of hybrid circuits used in the MEM. It includes the generation of engineering drawings and other design documents for the MEM and maintenance of these documents during the design period through Critical Design Review. This WBS element includes liaison with vendors and coordination with Materiel during the design and development period. This element includes all electronic, structural and thermal analyses of the Main Electronics Module at the component level and below. This element includes the effort to provide Electronics project management for the design and development period ending at the Critical Design Review. It includes cost and schedule planning, control, and statusing for all 46XX cost accounts during this period. This element includes all efforts associated with the preparation, organization, and presentation of all required internal design reviews regarding hardware or software items included in this WBS element. It includes all preparation and organization of materials relative to the activities of this WBS element in support of the MODIS-N system Preliminary Design Review and the Critical Design Review. Data package preparation and participation in these formal system-level reviews are included elsewhere in the WBS.

466X Electronics

This cost account includes all electronics subsystem engineering and circuit design, breadboarding, and breadboard testing associated with the Main Electronics Module (MEM), excluding the design of the power supply subassembly that is included in cost account 46GX. It includes the efforts associated with the design, fabrication, and testing of any proof-of-concept parts for design evaluation or life testing of hybrid circuits used in the MEM. It includes the generation of engineering drawings and other design documents for the MEM and maintenance of these documents during the design period through Critical Design Review. This cost account includes all electronic, structural and thermal analyses of the Main Electronics Module at the assembly level and below. This cost account includes liaison with vendors and coordination with Materiel regarding the MEM during the design and development period. This element includes the effort to provide Electronics project management for the design and development period ending at the Critical Design Review. It includes cost and schedule planning, control, and statusing for all 46XX cost accounts during this period. It includes technical, schedule, and financial oversight of the power supply development subcontract that is included in cost account 46GX. This element includes all efforts associated with the preparation, organization, and presentation of all required internal design reviews regarding hardware or software items included in this cost account. It includes all preparation and organization of materials relative to the activities of this cost account in support of the MODIS-N system Preliminary Design Review and the Critical Design Review. Data package preparation and participation in these formal system-level reviews are included elsewhere in the WBS.

46GX EDD

This cost account includes the effort of design and development of the power supply, including management, administration, circuit design, documentation, analysis,

breadboarding and test. It includes the updating and maintenance of the Power Supply Specification developed during the System Study, generation and maintenance of schematics for all electronic circuits, appropriate analytic simulation of circuit performance, generation and maintenance of parts lists, power estimates, and other relevant power supply documentation in support of the Electronics subsystem development. It includes all preparation and organization of materials relative to the activities of this cost account in support of the MODIS-N system Preliminary Design Review and the Critical Design Review. Data package preparation and participation in these formal system-level reviews are included elsewhere in the WBS.

46HX Electronics Packaging

This cost account includes all electronics packaging design associated with the Main Electronics Module (MEM), excluding the electronics packaging design of the power supply that is included in cost account 46GX. It includes determination of the packaging approach, the design and analysis of the mechanical housing for the MEM, the printed wiring boards, and interconnect cabling. It includes thermal and mechanical design analyses. This cost account includes the design and mockup of any harnesses that may be necessary to interconnect the Main Electronics Module with the Analog Electronics Modules, the On-Board Calibrators, Radiative Cooler, and other elements of the electrical subsystem. This cost account includes the design of cabling and harnessing internal to the Main Electronics Module required to interconnect the various printed wiring boards and other subassemblies within the module. It includes the generation of fabrication drawings and wire lists based on information supplied by the circuit design efforts included in 466X. This cost account includes liaison with vendors and coordination with Materiel during the design and development period. It includes cost and schedule planning, control, and statusing for the 46HX cost accounts during this period. This element includes all efforts associated with the preparation, organization, and presentation of all required internal design reviews regarding hardware or software items included in this WBS element. It includes all preparation and organization of materials relative to the activities of this cost account in support of the MODIS-N system Preliminary Design Review and the Critical Design Review. Data package preparation and participation in these formal system-level reviews are included elsewhere in the WBS.

47XX Analog Electronics Modules Design

This element includes all design and breadboarding activity associated with the Analog Electronics Modules (AEMs). It includes electronics circuit and packaging design. (The design and fabrication of a brassboard readout drive electronics assembly will provided under WBS-element 42XX). It includes the efforts associated with the design, fabrication, and testing of any proof-of-concept parts for design evaluation or life testing of hybrid circuits used in the AEMs. It includes the generation of schematic drawings and other circuit design documents for the Analog Electronic Modules and maintenance of these documents during the design period through Critical Design Review. This element includes all electronics, structural and thermal analyses of the Analog Electronics Module at the component level. It includes cost and schedule planning, control, and statusing for all 47XX cost accounts for the design and development period ending at the Critical Design Review. This WBS element includes liaison with vendors and coordination with Materiel regarding the AEMs during the design and development period. This element includes all efforts associated with the preparation, organization, and presentation of all required internal design reviews regarding hardware or software

items included in this WBS element. It includes all preparation and organization of materials relative to the activities of this WBS element in support of the MODIS-N system Preliminary Design Review and the Critical Design Review. Data package preparation and participation in these formal system-level reviews are included elsewhere in the WBS.

476X Electronics

This cost account includes all electronics subsystem engineering and circuit design, electronics circuit breadboarding, and circuit breadboard testing associated with the Analog Electronics Modules (AEMs). It includes the efforts associated with the design, fabrication, and testing of any proof-of-concept parts for design evaluation or life testing of hybrid circuits used in the AEMs. (The design and fabrication of a brassboard readout drive electronics assembly will provided by cost account 428X). It includes the generation of schematic drawings and other circuit design documents for the Analog Electronics Modules and maintenance of these documents during the design period through Critical Design Review. This cost account includes all electronics, structural and thermal analyses of the Analog Electronics Module at the assembly level and below. This cost account includes liaison with vendors and coordination with Materiel regarding the AEMs during the design and development period. It includes cost and schedule planning, control, and statusing for all 476X cost accounts for the design and development period ending at the Critical Design Review. This cost account includes all efforts associated with the preparation, organization, and presentation of all required internal design reviews regarding hardware or software items included in this WBS element. It includes all preparation and organization of materials relative to the activities of this cost account in support of the MODIS-N system Preliminary Design Review and the Critical Design Review. Data package preparation and participation in these formal system-level reviews are included elsewhere in the WBS.

47HX Electronics Packaging

This cost account includes all electronics packaging design associated with the the Analog Electronics Modules (AEMs). It includes determination of the packaging approach, the design and analysis of the mechanical housing for the AEMs, the printed wiring boards, and interconnect cabling. It includes thermal and mechanical design analyses for the AEM assemblies and subassemblies. This cost account includes the design and mockup of any harnesses that may be necessary to interconnect the Analog Electronics Modules with the VIS Focal Plane Assembly, NIR Focal Plane Assembly, and Radiative Cooler Assembly. This cost account includes the design of cabling and harnessing internal to the Analog Electronics Modules required to interconnect the various printed wiring boards and other subassemblies within the modules. It includes the generation and maintenance through CDR of fabrication drawings and wire lists based on information supplied by the circuit design efforts included in the 476X cost account. This cost account includes liaison with vendors and coordination with Materiel regarding the AEMs during the design and development period. It includes cost and schedule planning, control, and statusing for the 47HX cost account during this period. This element includes all efforts associated with the preparation, organization, and presentation of all required internal design reviews regarding hardware or software items included in this cost account. It includes all preparation and organization of materials relative to the activities of this cost account in support of the MODIS-N system Preliminary Design Review and the Critical Design Review. Data package preparation and

participation in these formal system-level reviews are included elsewhere in the WBS.

48XX On-Board Calibrators Design

This element includes all on-board calibrator activity, in coordination with system engineering end system analyses performed under element 2XXX which is necessary to assure that the instrument will satisfy the specifications. This element includes all design activity associated with the on-board Blackbody, the Solar Diffuser, the Solar Diffuser Stability Monitor, and the Spectroradiometric Calibrator. It includes the generation of engineering drawings and other design documents for the on-board calibrators and maintenance of these documents during the design period through Critical Design Review. It includes all electronics, optical, structural and thermal analyses of these components performed at the component level. It includes support of the contamination analyses performed by System Engineering. It includes cost and schedule planning, control, and statusing for all 48XX cost accounts for the design and development period ending at the Critical Design Review. This element includes all efforts associated with the preparation, organization, and presentation of all required internal design reviews regarding hardware or software items included in this WBS element. It includes all preparation and organization of materials relative to the activities of this WBS element in support of the MODIS-N system Preliminary Design Review and the Critical Design Review. Data package preparation and participation in these formal system-level reviews are included elsewhere in the WBS.

484X Mechanics

This element includes all mechanical design activity associated with the on-board calibrators, including the Blackbody, the Solar Diffuser, the Solar Diffuser Stability Monitor, and the Spectroradiometric Calibrator. It includes the generation of engineering drawings and other design documents for the mechanical parts, mechanisms, and subassemblies of the on-board calibrators and maintenance of these documents during the design period through Critical Design Review. It includes all structural and thermal analyses of these assemblies performed at the assembly level and below. It includes cost and schedule planning, control, and statusing for the 484X cost account during the design and development period ending at the Critical Design Review. This element includes all efforts associated with the preparation, organization, and presentation of all required internal design reviews regarding hardware or software items included in this cost account. It includes all preparation and organization of materials relative to the activities of this cost account in support of the MODIS-N system Preliminary Design Review and the Critical Design Review. Data package preparation and participation in these formal system-level reviews are included elsewhere in the WBS.

485X Optics

This element includes all optical design activity associated with the on-board calibrators, including the Blackbody, the Solar Diffuser, the Solar Diffuser Stability Monitor, and the Spectroradiometric Calibrator. It includes the generation of engineering drawings and other design documents for the optical parts of the on-board calibrators and maintenance of these documents during the design period through Critical Design Review. It includes all optical ray trace, optical sensitivity, and optical tolerancing analyses for the on-board calibrators. It includes cost and schedule planning, control, and statusing for the 485X cost account during the design and development period ending at the Critical Design Review. This element includes all efforts associated with the preparation, organization, and presentation of

all required internal design reviews regarding hardware or software items included in this cost account. It includes all preparation and organization of materials relative to the activities of this cost account in support of the MODIS-N system Preliminary Design Review and the Critical Design Review. Data package preparation and participation in these formal system-level reviews are included elsewhere in the WBS.

486X Electronics

This element includes all electronics and electronics packaging design activity associated with the on-board calibrators, including the Blackbody, the Solar Diffuser, the Solar Diffuser Stability Monitor, and the Spectroradiometric Calibrator. It includes the generation of engineering drawings and other design documents for the electronic subassemblies of the on-board calibrators and maintenance of these documents during the design period through Critical Design Review. It includes all electronics analyses for the on-board calibrators. It includes cost and schedule planning, control, and statusing for the 486X cost account during the design and development period ending at the Critical Design Review. This element includes all efforts associated with the preparation, organization, and presentation of all required internal design reviews regarding hardware or software items included in this cost account. It includes all preparation and organization of materials relative to the activities of this cost account in support of the MODIS-N system Preliminary Design Review and the Critical Design Review. Data package preparation and participation in these formal system-level reviews are included elsewhere in the WBS.

4AXX On-Board Software Development

This .element includes all development, flow charting, coding, documentation, etc. of instrument-based software/firmware necessary to assure that the instrument will satisfy the specification. It includes command and data handling functions within the instrument and between the instrument and the spacecraft. It includes cost and schedule planning, control, and statusing for all 4AXX cost accounts for the design and development period ending at the Critical Design Review. This element includes all efforts associated with the preparation, organization, and presentation of all required internal design reviews regarding hardware or software items included in this WBS element. It includes all preparation and organization of materials relative to the activities of this WBS element in support of the MODIS-N system Software Preliminary Design Review, the Software Test Readiness Review, and the Software Critical Design Review. Data package preparation and participation in these formal system-level reviews are included elsewhere in the WBS.

4A6X Electronics

Same as 4AXX.

5XXX TEST MODELS AND TEST COMPONENTS

51XX Test Models and Components

This element includes the fabrication and testing of the MODIS-N structural/thermal model required for instrument development and to fulfill requirements in the GIIS. This element includes the costs associated with the design, fabrication , and test of all life test assemblies and parts. It includes cost and schedule planning, control, and statusing for all 514X and 515X cost accounts. This element includes all efforts associated with the preparation, organization, and presentation of all required internal design reviews

regarding hardware or software items included in this WBS element. It includes all preparation and organization of materials relative to the activities of this WBS element in support of the MODIS-N system Preliminary Design Review and the Critical Design Review. Data package preparation and participation in these formal system-level reviews are included elsewhere in the WBS.

514X Mechanics

This cost account includes the fabrication and testing of the MODIS-N structural/thermal model required for instrument development and to fulfill requirements in the GIIS. It includes the costs associated with the design, fabrication, and test of life test articles for the scan mirror motor, bearings, and encoder, on-board calibration mechanisms, and thermal control louvers. It includes cost and schedule planning, control, and statusing for the 514X cost account. This element includes all efforts associated with the preparation, organization, and presentation of all required internal design reviews regarding items included in this cost account. It includes all preparation and organization of materials relative to the activities of this cost account in support of the MODIS-N system Preliminary Design Review and the Critical Design Review. Data package preparation and participation in these formal system-level reviews are included elsewhere in the WBS.

515X Optics

This cost account includes the costs associated with the design, fabrication, and test of life test articles for evaluating silver mirror coatings temporal stability, the SRCA tungsten ribbon filament source stability and life extent, and solar diffuser stability. It includes cost and schedule planning, control, and statusing for the 515X cost account. This element includes all efforts associated with the preparation, organization, and presentation of all required internal design reviews regarding items included in this cost account. It includes all preparation and organization of materials relative to the activities of this cost account in support of the MODIS-N system Preliminary Design Review and the Critical Design Review. Data package preparation and participation in these formal system-level reviews are included elsewhere in the WBS.

51BX Manufacturing

This cost account includes the assembly and manufacturing engineering labor required to support engineering in the design, fabrication, and test of any life test assemblies, structural/thermal models, harness mock-ups, and in the fabrication of two drill templates.

Assembly effort includes wiring, soldering, cable routing, harnessing, bonding, conformal coating, parts cleaning, priming and painting, assembly of parts, installation of pins and fasteners, fabrication of assembly aids, machining of parts, etc, and the supervision for these tasks.

Manufacturing Engineering effort includes development of the manufacturing schedule plan, design review, tool design, procurement and assembly/test planning instructions, ordering of parts, vendor liaison and technical support for procurement and assembly personnel.

The cost and schedule planning, control, and statusing for the 51BX cost account is included in cost account 15BX.

6XXX ENGINEERING MODEL

This element includes the effort, equipment, material, tests and calibrations to develop, fabricate, integrate and test the MODIS-N engineering model. It also includes the generation and updating of the required engineering drawings, assembly planning and support, vendor surveillance, preparation of test procedures, testing during fabrication and alignment, conduct of integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to each element within this task.

61XX Optical Assemblies and Mounts

This element includes the development, fabrication, and verification of the engineering model Afocal Telescope Assembly, and the aft-optics objective assemblies (VIS Objective, NIR Objective, SWIR/MWIR Objective, and LWIR Objective), the dichroic beamsplitters (Dichroic #1, Dichroic #2, and Dichroic #3) and their mounts, and the spectral filters for the VIS, NIR, SWIR/MWIR, and LWIR focal planes. The fabrication of the Optical Bench Housing is included in this element. The fabrication of the filter mounting hardware is included in element 62XX. This element includes the generation and the maintenance of required engineering drawings, assembly planning and support, manufacturing assembly, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of component integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for these optical assemblies and mounts. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for 614X and 615X cost accounts.

614X Mechanics

This element includes the development, fabrication, and verification of the mechanical parts of the engineering model Afocal Telescope Assembly, and the aft-optics objective assemblies (VIS Objective, NIR Objective, SWIR/MWIR Objective, and LWIR Objective), and the Dichroic Assembly. The fabrication of the Optical Bench Housing is included in this cost account. The fabrication of the filter mounting hardware is included in element 62XX. This element includes the generation and the maintenance of required mechanical engineering drawings, mechanical design support for assembly planning and mechanical assembly, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, mechanical design support of part integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the mechanical, thermal, or structural aspects of these optical assemblies and mounts. This cost account includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for the 614X cost account.

615X Optics

This element includes the development, fabrication, and verification of the optical parts and subassemblies of the engineering model Afocal Telescope Assembly, and the aft-optics objective assemblies (VIS Objective, NIR Objective, SWIR/MWIR Objective, and LWIR Objective), and the Dichroic Assembly. The procurement and installation of VIS, NIR, SWIR/MWIR, and LWIR spectral filters on the focal plane

filter bezels is included in this cost account. This element includes the generation and the maintenance of required optical engineering drawings, optical engineering support of assembly planning optical assembly, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, optical design support of part and subassembly integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the optical design aspects of these optical assemblies and mounts. This cost account includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for the 615X cost account.

61BX Manufacturing

This cost account includes the manufacturing effort associated with the Aft-Optics and Afocal Telescope optical assemblies and mounts. Assembly effort includes any wiring, soldering, cable routing, harnessing, bonding, conformal coating, certification of assemblers to workmanship specifications, parts cleaning, priming and painting, assembly of parts, installation of pins and fasteners, fabrication of assembly aids, machining of parts, etc, and supervision for the development, fabrication and verification of these assemblies and any special metering and/or support structures.

Manufacturing Engineering effort includes development of the manufacturing schedule plan, generation and maintenance of the manufacturing bill of material, design review, process development, tool design, procurement and assembly/test planning instructions, ordering of parts, vendor liaison and technical support for procurement and assembly personnel for the development, fabrication and verification of the afocal telescope assembly, and the aft-optics objective assemblies (VIS Objective, NIR Objective, SWIR/MWIR Objective, and LWIR Objective), the dichroic beamsplitters (Dichroic #1, Dichroic #2, and Dichroic #3) and their mounts, and the spectral filters for the VIS, NIR, SWIR/MWIR, and LWIR focal planes.

62XX Focal Plane Assemblies

This element includes the development, fabrication, and verification of the engineering model Focal Plane Assemblies (FPAs). It includes the complete fabrication of the VIS, NIR, and cold focal plane assemblies (SWIR/MWIR and LWIR bands). This element includes the generation and the maintenance of required engineering drawings, manufacture planning and scheduling, manufacturing assembly, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of part and subassembly integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for these focal plane assemblies. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes the effort associated with providing technical and programmatic direction to the Hughes Technology Center and coordinating the fabrication and delivery of the VIS and NIR sensor chip assemblies and all focal plane readout circuits. It includes cost and schedule planning, control, and statusing for 62XX cost accounts.

628X Focal Planes

This cost account includes the development, fabrication, and verification of the engineering model Focal Plane Assemblies (FPAs). It includes the complete

fabrication of the VIS, NIR, and cold focal plane assemblies (SWIR/MWIR and LWIR bands). This element includes the generation and the maintenance of required engineering drawings, manufacture planning and scheduling, manufacturing assembly, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of part and subassembly integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for these focal plane assemblies. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes the effort associated with providing technical and programmatic direction to the Hughes Technology Center and coordinating the fabrication and delivery of the VIS and NIR sensor chip assemblies and the focal plane readout circuits. It includes cost and schedule planning, control, and statusing for 628X cost account.

62FX HTC

This cost account includes the cost of processing, fabricating and testing the VIS and NIR sensor chip assemblies and all focal plane readout circuits for the Engineering Model. It includes cost and schedule planning, control, and statusing for the 62FX cost account.

63XX Mainframe Structure and Doors

This element includes the fabrication and testing of the mainframe structure and the system aperture, solar calibration, and radiative cooler anti-contamination door assemblies. The fabrication of actuators to control these doors and fabrication of the multi-layer insulation (MLI) thermal blankets are also included in this element. This element includes the generation and the maintenance of required engineering drawings, assembly planning and support, manufacturing assembly, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of part and subassembly integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the mainframe structure, doors, and MLI thermal blankets. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for all 634X cost accounts.

634X Mechanics

This element includes the fabrication and testing of the mainframe structure and the system aperture, solar calibration, and radiative cooler anti-contamination door assemblies. The fabrication of actuators to control these doors and fabrication of the multi-layer insulation (MLI) thermal blankets are also included in this element. This element includes the generation and the maintenance of required engineering drawings and technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of part and subassembly integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the mainframe structure, doors, and MLI thermal blankets. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for all 634X cost accounts.

63BX Manufacturing

This cost account includes the manufacturing effort associated with the mainframe structure and the system aperture, solar calibration, and radiative cooler anti-contamination door assemblies. Assembly effort includes any wiring, soldering, cable routing, harnessing, bonding, conformal coating, certification of assemblers to workmanship specifications, parts cleaning, priming and painting, assembly of parts, installation of pins and fasteners, fabrication of assembly aids, machining of parts, etc, and supervision for the development, fabrication and verification of these assemblies.

Manufacturing Engineering effort includes development of the manufacturing schedule plan, generation and maintenance of the manufacturing bill of material, design review, process development, tool design, procurement and assembly/test planning instructions, ordering of parts, vendor liaison and technical support for procurement and assembly personnel for the development, fabrication and verification of the mainframe structure and the system aperture, solar calibration, and radiative cooler anti-contamination door assemblies.

64XX Scan Mirror Assembly

This element includes the fabrication and testing of the scan mirror subsystem, except for the control electronics which are included in element 66XX. This element includes the fabrication and testing of the two-sided scan mirror, low distortion mirror mount, and the scan mirror and coatings, and the motor mount assembly. This element includes the generation and the maintenance of required engineering drawings, assembly planning and support, manufacturing assembly, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of part integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the two-sided scan mirror, low distortion mirror mount, the scan mirror and coatings, and the motor mount assembly. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for all 644X cost accounts.

644X Mechanics

This cost account includes the fabrication of engineering model parts for and testing of the low distortion mirror mount, the scan drive motor and encoder, and the motor mount assembly. It includes the generation and the maintenance of required engineering drawings, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of part and subassembly integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the low distortion mirror mount, the scan mirror drive motor and encoder, and the motor mount assembly. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for the 644X cost account.

645X Optics

This cost account includes the fabrication of engineering model parts for and testing of the two-sided scan mirror and coatings. This element includes the generation and the maintenance of required engineering drawings, technical vendor surveillance and

procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of optical part integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the scan mirror and coatings. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for the 645X cost account.

64BX Manufacturing

This cost account includes the manufacturing effort associated with the scan mirror subsystem, except for the control electronics which are included in element 66XX. Assembly effort includes any wiring, soldering, cable routing, harnessing, bonding, conformal coating, certification of assemblers to workmanship specifications, parts cleaning, priming and painting, assembly of parts, installation of pins and fasteners, fabrication of assembly aids, machining of parts, etc, and supervision for the development, fabrication and verification of these assemblies.

Manufacturing Engineering effort includes development of the manufacturing schedule plan, generation and maintenance of the manufacturing bill of material, design review, process development, tool design, procurement and assembly/test planning instructions, ordering of parts, vendor liaison and technical support for procurement and assembly personnel for the development, fabrication and verification of the scan mirror subsystem, except for the control electronics which are included in the 64BX cost account.

65XX Radiative Cooler Assembly

This element includes the fabrication and testing of the Radiative Cooler. It does not include the fabrication and testing of the radiative cooler anti-contamination door assembly which is included in WBS element 63XX or the Cold Focal Planes Assembly (CFPA) which is part of 628X. This element does not include the fabrication and testing of the Cold Focal Plane Assembly, but does include the fabrication of dewar stem which is incorporated as part of the CFPA prior to installation of the CFPA into the Radiative Cooler. This element includes the generation and the maintenance of required engineering drawings, assembly planning and support, manufacturing assembly, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of component integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the Radiative Cooler. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for all 654X cost accounts.

654X Mechanics

This element includes the fabrication of engineering model parts for and testing of the Radiative Cooler. It does not include the fabrication and testing of the radiative cooler anti-contamination door assembly which is included in WBS element 63XX or the Cold Focal Planes Assembly (CFPA) which is part of 628X. This cost account does, however, include the dewar stem which is part of the CFPA. This element includes the generation and the maintenance of required engineering drawings, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of component integration and performance tests, test data reduction and analysis, and preparation of

reports and special analyses for the Radiative Cooler. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for the 654X cost accounts.

65BX Manufacturing

This cost account includes the manufacturing effort associated with the Radiative Cooler. It does not include the fabrication and testing of the radiative cooler anti-contamination door assembly which is included in WBS element 63XX. Assembly effort includes any wiring, soldering, cable routing, harnessing, bonding, conformal coating, certification of assemblers to workmanship specifications, parts cleaning, priming and painting, assembly of parts, installation of pins and fasteners, fabrication of assembly aids, machining of parts, etc, and supervision for the development, fabrication and verification of these assemblies.

Manufacturing Engineering effort includes development of the manufacturing schedule plan, generation and maintenance of the manufacturing bill of material, design review, process development, tool design, procurement and assembly/test planning instructions, ordering of parts, vendor liaison and technical support for procurement and assembly personnel for the development, fabrication and verification of the Radiative Cooler. It does not include the fabrication and testing of the radiative cooler anti-contamination door assembly which is included in WBS element 63XX.

66XX Main Electronics Module

This element includes the fabrication and testing of the Main Electronics Module, including the fabrication of any harnesses that may be necessary to interconnect the Main Electronics Module with the Analog Electronics Modules, the On-Board Calibrators, and other elements of the electrical subsystem. This element includes the generation and the maintenance of required circuit design schematics, technical vendor surveillance and procurement support, assembly support, preparation of test procedures, testing during fabrication, conduct of part and subassembly integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the Main Electronics Module. This element includes the cost of electronics parts and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for all 666X, 66GX, and 66HX cost accounts.

666X Electronics

This cost account includes the technical guidance and oversight, fabrication and procurement of parts, support to manufacturing, and testing of the engineering model Main Electronics Module. This cost account includes the generation and the maintenance of required engineering drawings, technical vendor surveillance and procurement support, manufacturing assembly support, preparation of assembly and subassembly test procedures, testing during fabrication and alignment, conduct of subassembly integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the engineering model Main Electronics Module. This element includes the cost of engineering model materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It

includes cost and schedule planning, control, and statusing for the 666X cost account.

66BX Manufacturing

This cost account includes the manufacturing effort associated with the Main Electronics Module, including the fabrication of any harnesses that may be necessary to interconnect the Main Electronics Module with the Analog Electronics Modules, the On-Board Calibrators, and other elements of the electrical subsystem. Assembly effort includes any wiring, soldering, cable routing, harnessing, bonding, conformal coating, certification of assemblers to workmanship specifications, parts cleaning, priming and painting, assembly of parts, installation of pins and fasteners, fabrication of assembly aids, machining of parts, etc, and supervision for the development, fabrication and verification of these assemblies.

Manufacturing Engineering effort includes development of the manufacturing schedule plan, generation and maintenance of the manufacturing bill of material, design review, process development, tool design, procurement and assembly/test planning instructions, ordering of parts, vendor liaison and technical support for procurement and assembly personnel for the development, fabrication and verification of the Main Electronics Module, including the fabrication of any harnesses that may be necessary to interconnect the Main Electronics Module with the Analog Electronics Modules, the On-Board Calibrators, and other elements of the electrical subsystem.

66GX EDD

This element includes the fabrication, manufacture, test, and delivery of one complete Instrument set of MODIS-N Power Supply hardware, including any redundancy present in a flight instrument, for inclusion into the Engineering Model MODIS-N. The Engineering Model hardware shall be identical to flight hardware in form, fit, and function, but may be built with less quality verification oversight, both in manufacture and in the piece parts employed. The task includes generation of any special test procedures and the purchase and/or fabrication of any special fixtures and test equipment. It includes cost and schedule planning, control, and statusing of the 66GX account.

66HX Electronics Packaging

This cost account includes the fabrication and procurement of the Main Electronics Module housing, printed wiring boards, internal interconnect harnessing, and any harnesses that may be necessary to interconnect the Main Electronics Module with the Analog Electronics Modules, the On-Board Calibrators, and other elements of the electrical subsystem. It includes support of manufacturing assembly and electronics test activities. This cost account includes the generation and the maintenance of required electronics packaging drawings, technical vendor surveillance and procurement support, and preparation of reports and special analyses for the Main Electronics Module packaging. This cost account includes the cost of electronics packaging materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for the 66HX cost account.

67XX Analog Electronics Modules

This element includes the fabrication and testing of the Analog Electronics Modules. This element includes the generation and the maintenance of required engineering

drawings, assembly planning and support, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of component and assembly integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the Analog Electronics Modules. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for all 676X and 67HX cost accounts.

676X Electronics

This cost account includes the technical guidance and oversight, fabrication and procurement of parts, support to manufacturing, and testing of the engineering model Analog Electronics Modules. This cost account includes the generation and the maintenance of required engineering drawings, technical vendor surveillance and procurement support, manufacturing assembly support, preparation of assembly and subassembly test procedures, testing during fabrication and alignment, conduct of subassembly integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the engineering model Main Electronics Module. This element includes the cost of engineering model materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for the 676X cost account.

67BX Manufacturing

This cost account includes the manufacturing effort associated with the Analog Electronics Modules. Assembly effort includes any wiring, soldering, cable routing, harnessing, bonding, conformal coating, certification of assemblers to workmanship specifications, parts cleaning, priming and painting, assembly of parts, installation of pins and fasteners, fabrication of assembly aids, machining of parts, etc, and supervision for the development, fabrication and verification of these assemblies.

Manufacturing Engineering effort includes development of the manufacturing schedule plan, generation and maintenance of the manufacturing bill of material, design review, process development, tool design, procurement and assembly/test planning instructions, ordering of parts, vendor liaison and technical support for procurement and assembly personnel for the development, fabrication and verification of the Analog Electronics Modules.

67HX Electronics Packaging

This cost account includes the fabrication and procurement of the housings for the Analog Electronics Modules, printed wiring boards, and internal interconnect harnessing, and any harnesses that may be necessary to interconnect the analog Electronics Modules with the Radiative Coolers. It includes support of manufacturing assembly and electronics test activities. This cost account includes the generation and the maintenance of required electronics packaging drawings, technical vendor surveillance and procurement support, and preparation of reports and special analyses for the Analog Electronics Module packaging. This cost account includes the cost of electronics packaging materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for the 67HX cost account.

68XX On-Board Calibrators

This element includes the fabrication and testing of the on-board Blackbody Assembly, the Solar Diffuser Assembly, the Solar Diffuser Stability Monitor assembly, and the Spectroradiometric Calibrator Assembly. It includes the generation and the maintenance of required engineering drawings, assembly planning and support, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of part and subassembly integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the On-Board Calibrators. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for all 684X, 685X, and 686X cost accounts.

684X Mechanics

This cost account includes the mechanical engineering support for manufacturing activities included in 68BX and fabrication of the mechanical parts for the on-board Blackbody Assembly, the Solar Diffuser Assembly, the Solar Diffuser Stability Monitor assembly, and the Spectroradiometric Calibrator Assembly. It includes the generation and the maintenance of required engineering drawings, technical vendor surveillance and procurement support, support of part and subassembly integration and performance tests, mechanical test data reduction and analysis, and preparation of reports and special mechanical, thermal, and structural analyses for the On-Board Calibrators. This cost account includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for the 684X cost account.

685X Optics

This cost account includes the optical engineering support for manufacturing activities included in 68BX and fabrication of the optical parts for the on-board Blackbody Assembly, the Solar Diffuser Assembly, the Solar Diffuser Stability Monitor assembly, and the Spectroradiometric Calibrator Assembly. It includes the generation and the maintenance of required engineering drawings, technical vendor surveillance and procurement support, support of part and subassembly integration and performance tests, optical test data reduction and analysis, and preparation of reports and special optical analyses for the On-Board Calibrators. This cost account includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for the 685X cost account.

686X Electronics

This cost account includes the electronics and electronics packaging engineering support for manufacturing activities included in 68BX and procurement of the electronic parts and fabrication of the electronics subassemblies for the on-board Blackbody Assembly, the Solar Diffuser Assembly, the Solar Diffuser Stability Monitor assembly, and the Spectroradiometric Calibrator Assembly. It includes the generation and the maintenance of required engineering drawings, technical vendor surveillance and procurement support, support of electronics part and subassembly integration and performance tests, electronics test data reduction and analysis, and preparation of reports and special electronics analyses for the On-Board Calibrators. This cost account includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special

fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for the 686X cost account.

68BX Manufacturing

This cost account includes the manufacturing effort associated with the on-board Blackbody Assembly, the Solar Diffuser Assembly, the Solar Diffuser Stability Monitor assembly, and the Spectroradiometric Calibrator Assembly. Assembly effort includes any wiring, soldering, cable routing, harnessing, bonding, conformal coating, certification of assemblers to workmanship specifications, parts cleaning, priming and painting, assembly of parts, installation of pins and fasteners, fabrication of assembly aids, machining of parts, etc, and supervision for the development, fabrication and verification of these assemblies.

Manufacturing Engineering effort includes development of the manufacturing schedule plan, generation and maintenance of the manufacturing bill of material, design review, process development, tool design, procurement and assembly/test planning instructions, ordering of parts, vendor liaison and technical support for procurement and assembly personnel for the development, fabrication and verification of the on-board Blackbody Assembly, the Solar Diffuser Assembly, the Solar Diffuser Stability Monitor assembly, and the Spectroradiometric Calibrator Assembly.

69XX Integration, Test & Calibration

This element includes the integration of all assemblies into a complete MODIS-N engineering model and its test and calibration. It includes integration, final assembly, system-level alignment, inspection check lists, conduct of performance and environmental tests, instrument calibration, mass property measurement, compatibility tests, test data collection, reduction and analyses and issuance of test reports. This element includes the generation and the maintenance of required engineering drawings, assembly planning and support, technical vendor surveillance and procurement support. This element includes the cost of materials and subcontracts required to support the system Integration, Test, & Calibration activity that are not covered elsewhere in the WBS. It includes cost and schedule planning, control, and statusing for all 69EX cost accounts.

69BX Manufacturing

This cost account includes the manufacturing support necessary to accomplish the integration of assemblies into a complete MODIS-N instrument, and support of the test and calibration effort. It includes final assembly, integration and alignment and support of the inspection, performance tests, environmental tests, calibration, mass property measurement, compatibility tests, test data collection and analyses.

Manufacturing Engineering effort includes development of the manufacturing schedule plan, process development, tool design, assembly/test planning instructions, and technical support for assembly personnel during the final assembly, integration and alignment. It includes supporting the inspection, performance tests, environmental tests, calibration, mass property measurement, compatibility tests, test data collection and analyses.

69EX System Test

This cost account includes the technical direction and oversight of the Integration, Test, and Calibration of the Engineering Model. It includes all effort (excluding

manufacturing support) for the integration of all assemblies into a complete MODIS-N engineering model and its test and calibration. It includes integration, final assembly, system-level alignment, inspection check lists, conduct of performance and environmental tests, instrument calibration, mass property measurement, compatibility tests, test data collection, reduction and analyses and issuance of test reports. Environmental tests include ambient, baseline performance tests, electromagnetic compatibility tests, shock tests, modal-survey tests, and thermal vacuum performance tests. This element includes the generation and the maintenance of required engineering drawings and technical vendor surveillance and procurement support. This element includes the cost of all materials and subcontracts required to support the system Integration, Test, & Calibration activity that are not covered elsewhere in the WBS. It includes cost and schedule planning, control, and statusing for the 69EX cost account.

6AXX On-Board Software Maintenance

This .element includes the maintenance of all on-board software for the Engineering Model.

6A6X Electronics

Same as 6AXX.

7XXX PROTOFLIGHT MODEL

This element includes the effort, equipment, materials, and tests required to develop, fabricate, integrate, qualify, test (and refurbish, if necessary) the MODIS-N Protoflight Model. It also includes updating engineering drawings and assembly planning and support, vendor surveillance, preparation of qualification and test procedures, testing during fabrication and alignment, conduct of integration, qualification and performance tests, test data reduction and analyses and preparation of reports and special analyses. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to each element within this task.

71XX Optical Assemblies and Mounts

This element includes the development, fabrication, and verification of the Protoflight Model Afocal Telescope Assembly, and the aft-optics objective assemblies (VIS Objective, NIR Objective, SWIR/MWIR Objective, and LWIR Objective), the dichroic beamsplitters (Dichroic #1, Dichroic #2, and Dichroic #3) and their mounts, and the spectral filters for the VIS, NIR, SWIR/MWIR, and LWIR focal planes. The fabrication of the Optical Bench Housing is included in this element. The fabrication of the filter mounting hardware is included in element 72XX. The installation of the spectral filters in the filter bezel is included in this element. The procurement and installation of VIS, NIR, SWIR/MWIR, and LWIR spectral filters on the focal plane filter bezels is included in this element. This element includes the generation and the maintenance of required engineering drawings, manufacture planning and scheduling, manufacturing assembly, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of component integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for these optical assemblies and mounts. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for 714X and 715X cost accounts.

714X Mechanics
This cost account is equivalent to 614X.
715X Optics
This cost account is equivalent to 615X.
71BX Manufacturing
This cost account is equivalent to 61BX.

72XX Focal Plane Assemblies

This element includes the development, fabrication, and verification of the Protoflight Model Focal Plane Assemblies (FPAs). It includes the complete fabrication of the VIS Focal Plane Assembly, NIR Focal Plane Assembly, and the Cold Focal Plane Assembly (CFPA), except for the spectral filters which will be provided under WBS-element 71XX and the CFPA platform (dewar stem) which will be provided under WBS-element 75XX. This element includes the generation and the maintenance of required engineering drawings, manufacture planning and scheduling, manufacturing assembly, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of component integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for these focal plane assemblies. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes the effort associated with providing technical and programmatic direction to the Hughes Technology Center and coordinating the fabrication and delivery of the VIS and NIR sensor chip assemblies and the infrared focal plane readout circuits. It includes cost and schedule planning, control, and statusing for 72XX cost accounts.

728X Focal Planes
This cost account is equivalent to 628X.
72FX HTC
This cost account is equivalent to 62FX.

73XX Mainframe Structure and Doors

This element includes the fabrication and testing of the Protoflight Model mainframe structure and the system aperture, solar calibration, and radiative cooler anti-contamination door assemblies. The fabrication of actuators to control these doors and fabrication of the multi-layer insulation (MLI) thermal blankets are also included in this element. This element includes the generation and the maintenance of required engineering drawings, manufacture planning and scheduling, manufacturing assembly, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of component integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the mainframe structure, doors, and MLI thermal blankets. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for all 73XX cost accounts.

734X Mechanics
This cost account is equivalent to 634X.
73BX Manufacturing
This cost account includes the same tasks as 63BX.

74XX Scan Mirror Assembly

This element includes the fabrication and testing of the Protoflight Model Scan Mirror subsystem, except for the control electronics which are included in element 66XX. This element includes the fabrication and testing of the two-sided scan mirror, low distortion mirror mount, and the scan mirror and coatings, and the motor mount assembly. This element includes the generation and the maintenance of required engineering drawings, manufacture planning and scheduling, manufacturing assembly, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of part integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the two-sided scan mirror, low distortion mirror mount, the scan mirror and coatings, and the motor mount assembly.. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for all 74XX cost accounts.

744X Mechanics
This cost account is equivalent to 644X.

745X Optics
This cost account is equivalent to 645X.

74BX Manufacturing

75XX Radiative Cooler Assembly

This element includes the fabrication and testing of the Protoflight Model Radiative Cooler. It does not include the fabrication and testing of the radiative cooler anti-contamination door assembly which is included in WBS element 63XX. This element does not include the fabrication and testing of the Cold Focal Plane Assembly, but does include the fabrication of the dewar stem which is incorporated as part of the CFPA prior to installation of the CFPA into the Radiative Cooler. This element includes the generation and the maintenance of required engineering drawings, manufacture planning and scheduling, manufacturing assembly, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of component integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the Radiative Cooler. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for all 75XX cost accounts.

754X Mechanics
This cost account is equivalent to 654X.

75BX Manufacturing
This cost account is equivalent to 65BX.

76XX Main Electronics Module

This element includes the fabrication and testing of the Protoflight Model Main Electronics Module, including the fabrication of any harnesses that may be necessary to interconnect the Main Electronics Module with the Analog Electronics Modules, the On-Board Calibrators, and other elements of the electrical subsystem. This element includes the generation and the maintenance of required engineering drawings, manufacture planning and scheduling, technical vendor surveillance and procurement support, manufacturing assembly, preparation of test procedures, testing during fabrication and

alignment, conduct of component and assembly integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the Main Electronics Module. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for all 76XX cost accounts.

766X Electronics
This cost account is equivalent to 666X.

76BX Manufacturing
This cost account includes the same tasks as 66BX.

76GX EDD
This cost account is equivalent to 66GX.

76HX Electronics Packaging
This cost account is equivalent to 66HX.

77XX Analog Electronics Modules

This element includes the fabrication and testing of the Protoflight Model Analog Electronics Modules. This element includes the generation and the maintenance of required engineering drawings, manufacture planning and scheduling, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of component and assembly integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the Analog Electronics Modules. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for all 77XX cost accounts.

776X Electronics
This cost account is equivalent to 676X.

77BX Manufacturing
This cost account is equivalent to 678X.

77HX Electronics Packaging
This cost account is equivalent to 67HX.

78XX On-Board Calibrators

This element includes the fabrication and testing of the Protoflight Model On-Board Calibrators including the Blackbody, the Solar Diffuser, the Solar Diffuser Stability Monitor, and the Spectroradiometric Calibrator. It includes the generation and the maintenance of required engineering drawings, manufacture planning and scheduling, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of component and assembly integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the On-Board Calibrators. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for all 78XX cost accounts.

784X Mechanics
This cost account is equivalent to 684X.

785X Optics
This cost account is equivalent to 685X.

786X Electronics

This cost account is equivalent to 686X.

78BX Manufacturing

This cost account is equivalent to 68BX.

79XX Integration, Test & Calibration

This element includes the integration of all components/assemblies into a complete MODIS-N Protoflight Model and its test and calibration. It includes integration, final assembly, system-level alignment, inspection check lists, conduct of performance and environmental tests, instrument calibration, mass property measurement, compatibility tests, test data collection, reduction and analyses and issuance of test reports. This element includes the generation and the maintenance of required engineering drawings, assembly planning and support, technical vendor surveillance and procurement support. This element includes the cost of materials and subcontracts required to support the System Integration, Test, & Calibration activity that are not covered elsewhere in the WBS. It includes, for the period beginning with the completion of GSE verification testing to delivery of the Protoflight Model, all effort to sustain, maintain, and periodically calibrate the Ground Support Equipment, including any maintenance contracts for commercial equipment and software. It includes cost and schedule planning, control, and statusing for the 79EX cost account.

79BX Manufacturing

This cost account is equivalent to 69BX.

79EX System Test

This cost account is equivalent to 69EX. Additional environmental testing includes vibration testing and acoustics testing; the modal survey test is optional. Provide, for the period beginning with the completion of verification testing to delivery of the Protoflight Model, all effort to sustain, maintain, and periodically calibrate the Ground Support Equipment, including any maintenance contracts for commercial equipment and software.

7AXX On-Board Software Maintenance

This .element includes the maintenance of all on-board software for the Protoflight Model.

7A6X Electronics

Same as 7AXX.

7BXX Protoflight Refurbishment

This element includes the partial disassembly of the instrument, replacement of particular critical components and re-assembly to flight configuration. It includes the required retesting and calibration of the MODI-N Protoflight Model to bring it up to flight worthiness.

7BBX Manufacturing

This cost account includes the manufacturing effort necessary for partial disassembly of the instrument, replacement of particular critical components and re-assembly to flight condition.

Manufacturing Engineering effort includes development of manufacturing schedule plan, process development, tool design, assembly planning instructions, and technical support for assembly during the refurbishment effort.

7CXX Spares

This element includes all the planning, procurement, fabrication, testing, qualification, and storage of spares necessary for the maintenance of the MODIS-N flight models and the GSE. The plans for meeting the spares needs of the MODIS-N Program are document in the Spares program plan (CDRL 035). The cost of any refurbishment and repairs is allocated to other appropriate elements in the corresponding elements of this WBS.

7C4X Mechanics

This cost account includes the materials and labor (excluding manufacturing labor) necessary to provide the mechanical spare parts and opto-mechanical subassemblies and assemblies needed to satisfy the MODIS-N Spares Program.

7C5X Optics

This cost account includes the materials and labor (excluding manufacturing labor) necessary to provide the optical spare parts needed to satisfy the MODIS-N Spares Program.

7C6X Electronics

This cost account includes the materials and labor (excluding manufacturing labor) necessary to provide the electronic spare parts, subassemblies, and assemblies needed to satisfy the MODIS-N Spares Program.

7C8X Focal Planes

This cost account includes the materials and labor necessary to provide the spare focal plane assemblies necessary to satisfy the MODIS-N Spares Program. The Spares Program Plan (CDRL 035), dated June 1991, includes one fully tested CFPA (aka Cold Stage Assembly) excluding the installation of the filter bezel assembly. The Plan also includes the filters and mounting hardware necessary to complete the CFPA and a spare Signal Cable Assembly (with connector mounted and tested for shorts and opens), The Spares Plan includes a VIS Module Assembly and a NIR Module Assembly. Each module is to be functionally tested to verify performance after assembly. The VIS and NIR sensor chip assemblies and the readout integrated circuits are provided under 7CGX.

7CAX GSE

This cost account includes the materials and labor necessary to provide the Ground Support Equipment spare parts, subassemblies, assemblies, and components needed to satisfy the MODIS-N Spares Program.

7CBX Manufacturing

The Manufacturing manager will administer the Spares Program. The cost of this administration activity is part of cost account 15BX.

This cost account includes the production/material control effort necessary to generate purchase requisitions, track purchased items, receive into bonded stores, kit parts for assembly, track parts in work-in-process and maintain piece-parts/completed assemblies in nitrogen-purged dry boxes.

Manufacturing Engineering effort includes support during the assembly and test/evaluation period. It does not include writing new assembly planning. Includes assistance to assembly and support to the test/evaluation activity and disposition of hardware as required.

Assembly effort includes wiring, soldering, cable routing, harnessing, bonding, conformal coating, parts cleaning, priming and painting, assembly of parts,

installation of pins and fasteners, machining of parts, etc, and supervision for the assembly of those items specified in the Spare Parts Plan.

7CGX HTC
This cost account includes the materials and labor necessary to provide the spare VIS and NIR focal plane assemblies and all readout assemblies necessary to satisfy the MODIS-N Spares Program. See 7C8X for the focal plane spares defined by the Spares Program Plan (CDRL 035), dated June 1991

8XXX FLIGHT MODEL 1

81XX Optical Assemblies and Mounts

This element includes the development, fabrication, and verification of the Flight Model 1 Afocal Telescope Assembly, and the aft-optics objective assemblies (VIS Objective, NIR Objective, SWIR/MWIR Objective, and LWIR Objective), the dichroic beamsplitters (Dichroic #1, Dichroic #2, and Dichroic #3) and their mounts, and the spectral filters for the VIS, NIR, SWIR/MWIR, and LWIR focal planes. The fabrication of the Optical Bench Housing is included in this element. The fabrication of the filter mounting hardware is included in element 82XX. This element includes the generation and the maintenance of required engineering drawings, assembly planning and support, manufacturing assembly, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of component integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for these optical assemblies and mounts. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for 614X and 615X cost accounts.

814X Mechanics
This cost account is equivalent to 614X.

815X Optics
This cost account is equivalent to 615X.

81BX Manufacturing
This cost account is equivalent to 61BX.

82XX Focal Plane Assemblies

This element includes the development, fabrication, and verification of the Flight Model 1 Focal Plane Assemblies (FPAs). It includes the complete fabrication of the VIS Focal Plane Assembly, NIR Focal Plane Assembly, and the Cold Focal Plane Assembly (CFPA), except for the spectral filters which will be provided under WBS-element 81XX and the CFPA platform (dewar stem) which will be provided under WBS-element 85XX. This element includes the generation and the maintenance of required engineering drawings, manufacture planning and scheduling, manufacturing assembly, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of component integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for these focal plane assemblies. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes the effort

associated with providing technical and programmatic direction to the Hughes Technology Center and coordinating the fabrication and delivery of the VIS and NIR sensor chip assemblies and all focal plane readout circuits. It includes cost and schedule planning, control, and statusing for 82XX cost accounts.

828X Focal Planes
This cost account is equivalent to 628X.

82FX HTC
This cost account is equivalent to 62FX.

83XX Mainframe Structure and Doors

This element includes the fabrication and testing of the Flight Model 1 mainframe structure and the system aperture, solar calibration, and radiative cooler anti-contamination door assemblies. The fabrication of actuators to control these doors and fabrication of the multi-layer insulation (MLI) thermal blankets are also included in this element. This element includes the generation and the maintenance of required engineering drawings, assembly planning and support, manufacturing assembly, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of component integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the mainframe structure, doors, and MLI thermal blankets. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for all 834X cost accounts.

834X Mechanics
This cost account is equivalent to 634X.

83BX Manufacturing
This cost account is equivalent to 63BX.

84XX Scan Mirror Assembly

This element includes the fabrication and testing of the Flight Model 1 scan mirror subsystem, except for the control electronics which are included in element 86XX. This element includes the fabrication and testing of the two-sided scan mirror, low distortion mirror mount, and the scan mirror and coatings, and the motor mount assembly. This element includes the generation and the maintenance of required engineering drawings, assembly planning and support, manufacturing assembly, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of part integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the two-sided scan mirror, low distortion mirror mount, the scan mirror and coatings, and the motor mount assembly.. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for all 844X and 845X cost accounts.

844X Mechanics
This cost account is equivalent to 644X.

845X Optics
This cost account is equivalent to 645X.

84BX Manufacturing
This cost account is equivalent to 64BX.

85XX Radiative Cooler Assembly

This element includes the fabrication and testing of the Radiative Cooler. It does not include the fabrication and testing of the radiative cooler anti-contamination door assembly which is included in WBS element 83XX. This element does not include the fabrication and testing of the Cold Focal Plane Assembly, but does include the fabrication of dewar stem which is incorporated as part of the CFPA prior to installation of the CFPA into the Radiative Cooler. This element includes the generation and the maintenance of required engineering drawings, assembly planning and support, manufacturing assembly, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of component integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the Radiative Cooler. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for all 854X cost accounts.

854X Mechanics
This cost account is equivalent to 654X.

85BX Manufacturing
This cost account is equivalent to 655X.

86XX Main Electronics Module

This element includes the fabrication and testing of the Flight Model 1 Main Electronics Module, including the fabrication of any harnesses that may be necessary to interconnect the Main Electronics Module with the Analog Electronics Modules, the On-Board Calibrators, and other elements of the electrical subsystem. This element includes the generation and the maintenance of required engineering drawings, assembly planning and support, technical vendor surveillance and procurement support, manufacturing assembly, preparation of test procedures, testing during fabrication and alignment, conduct of component and assembly integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the Main Electronics Module. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for all 866X, 86GX, and 86HX cost accounts.

866X Electronics
This cost account is equivalent to 666X.

86BX Manufacturing
This cost account is equivalent to 66BX.

86GX EDD
This cost account is equivalent to 66GX.

86HX Electronics Packaging
This cost account is equivalent to 66HX.

87XX Analog Electronics Modules

This element includes the fabrication and testing of the Flight Model 1 Analog Electronics Modules. This element includes the generation and the maintenance of required engineering drawings, assembly planning and support, technical vendor surveillance and procurement support, preparation of test procedures, testing during

fabrication and alignment, conduct of component and assembly integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the Analog Electronics Modules. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for all 876X and 87HX cost accounts.

876X Electronics
This cost account is equivalent to 676X.

87BX Manufacturing
This cost account is equivalent to 676X.

87HX Electronics Packaging
This cost account is equivalent to 67HX.

88XX On-Board Calibrators

This element includes the fabrication and testing of the Flight Model 1 On-Board Calibrators, including the Blackbody, the Solar Diffuser, the Solar Diffuser Stability Monitor, and the Spectroradiometric Calibrator. It includes the generation and the maintenance of required engineering drawings, assembly planning and support, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of component and assembly integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the On-Board Calibrators. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for all 884X, 885X, and 886X cost accounts.

884X Mechanics
This cost account is equivalent to 684X.

885X Optics
This cost account is equivalent to 685X.

886X Electronics
This cost account is equivalent to 686X.

88BX Manufacturing
This cost account is equivalent to 68BX.

89XX Integration, Test & Calibration

This element includes the integration of all components/assemblies into a complete MODIS-N Flight Model and its test and calibration. It includes integration, final assembly, system-level alignment, inspection check lists, conduct of performance and environmental tests, instrument calibration, mass property measurement, compatibility tests, test data collection, reduction and analyses and issuance of test reports. This element includes the generation and the maintenance of required engineering drawings, assembly planning and support, technical vendor surveillance and procurement support. This element includes the cost of materials and subcontracts required to support the System Integration, Test, & Calibration activity that are not covered elsewhere in the WBS. It includes, for the period beginning with the shipment of the PFM to delivery of the Flight Model 1, all effort to sustain, maintain, and periodically calibrate the Ground Support Equipment, including any maintenance contracts for commercial equipment and software. It includes cost and schedule planning, control, and statusing for all 89EX cost accounts.

89BX Manufacturing

This cost account is equivalent to 69BX.

89EX System Test

This cost account is equivalent to 79EX.

8AXX On-Board Software Maintenance

This element includes the maintenance of all on-board software. It includes cost and schedule planning, control, and statusing for all 8AXX cost accounts.

8A6X Electronics

Same as 8AXX.

8DXX Storage & Storage Test

This element includes the effort, equipment, materials and verification necessary to store the completed Flight Model 1 until the time for integration on a spacecraft. It includes storage environment requirements, scheduled storage testing and evaluation, and a complete post-storage/pre-integration test and calibration sequence.

8DEX System Test

Same as 8DXX.

9XXX GROUND SUPPORT EQUIPMENT

This element includes the effort,materials,and subcontracts required to design, develop, fabricate and test the MODIS-N Ground Support Equipment (GSE). The GSE consists of two functionally identical sets of System Test Equipment (STE), STE 1 and STE2, one Bench Check Unit (BCU), test fixtures, and calibration equipment. It also includes updating of drawings, manufacture planning and scheduling, vendor surveillance, preparation of test and checkout procedures, performance of checkout tests, test data analysis and reduction, and preparation of reports, manuals, and special analyses. All the breadboarding and special testing required to design, develop, fabricate and test the major subsystems of the GSE are included in the appropriate Level 3 elements below. The cost for all Level 3 subsystems of the task include the cost of materials and subcontracts, as well as the generation of special test procedures and purchase and/or fabrication of special test equipment related to each element within this task.

91XX GSE Administration & Systems Engineering

This element covers all the effort and analyses required to establish a firm set of requirements for the GSE designs. It covers the establishment of design specifications for the STE, BCU, required fixtures and stimuli, and information presentation devices. It also includes definition of GSE software requirements necessary to verify and calibrate the instrument.

91AX GSE

This account includes the project management of the Ground Support Equipment effort. It includes support by a project cost account administrator for tracking cost and schedule progress. The Project manager is responsible for the overall cost and schedule control and coordination of the Ground Support Equipment project. He develops the GSE cost accounts, work packages, schedules, and sets milestones and other evaluation criteria to monitor the performance of the project. He provides technical direction and leadership in the design and development effort and has overall technical responsibility for the Ground Support Equipment.

This account also includes the Ground Support Equipment System Engineering effort. The GSE System Engineer is responsible for the overall system engineering. His task includes the effort and analysis required to establish a firm set of

requirements for the GSE designs leading to formal design specifications. He allocates design requirements to the various design disciplines, and has responsibility for allocating the GSE requirements to specific hardware or software design tasks. The GSE system engineer has the responsibility for assuring that each GSE requirement is met and that the GSE performs its intended function. He bears overall responsibility for the development of GSE system documentation including specifications, system models, design documents, test plans and procedures, and verification and acceptance procedures. The GSE System Engineer is responsible for setting up and coordinating internal design reviews of the GSE hardware and software throughout the development process.

92XX GSE Software

This element includes all the computer code, documentation and manuals required to operate, verify and calibrate the instrument, and to display the instrument output in quickly grasped formats, including images.

92AX GSE

This account includes the planning, documentation, design, implementation and testing of the Ground Support Equipment Software. It includes the function of GSE software management, development of software documentation, internal software walk-throughs and reviews, and management of the software development and GSE computer resources. This cost account includes the development of software to support the focus and alignment of the MODIS-N Aft Optics assemblies. The software development process includes the following phases: Requirements Analysis, Architecture Design, Detailed Design, Implementation, Integration and Test, Acceptance Verification Testing, and Delivery. The preparation of CDRL 508 (Procurement Document) is included in this cost account. After delivery of the software, this account includes a transition period of calibration and maintenance support from the development to the sustaining engineering team.

93XX System Test Equipment and Bench Check Unit

This element includes the STE 1, STE 2, and the BCU as required by the specification. It also includes the mechanical and electrical design, engineering and test planning, and checkout of any fixtures required for the focus and alignment of the MODIS-N Aft Optics assemblies.

93AX GSE

This account covers the electrical and mechanical design of the two STE units and BCU hardware, procurement, printed wiring board layout, fabrication & assembly, and checkout. It includes labor associated with full integration of the two STE units and BCU with software and the performance of verification and acceptance testing. STE and BCU engineers will participate in internal design reviews held throughout the design and development process. Also included is the design and development of specialized interfaces and other hardware associated with the vacuum testing environment. This cost account also includes the design, engineering and test planning, and checkout of any fixtures required for the focus and alignment of the MODIS-N Aft Optics assemblies.

94XX System Test Fixtures & Shipping Containers

This element includes the primary test fixture and all other fixtures and equipment (such as the bench test cooler) necessary to operate and verify performance at all spectral bands

of the instrument in a clean room. It includes all equipment and fixtures unique to verification and calibration in thermal vacuum chambers in order to meet the requirements of the specification. It includes the planning and fabrication of focus and alignment fixtures required for the MODIS-N Aft Optics assemblies. This element includes all expendables to be used during the MODIS-N program, such as liquid nitrogen, magnetic tapes, special films or papers for images, etc. It also includes shipping containers and shipping costs of the instrument models, and of all GSE to be shipped to the spacecraft contractor for support of integration to the spacecraft, and for any pre- and post-launch instrument performance analyses conducted at the spacecraft contractor's facility.

94AX GSE

Same as 94XX.

95XX Optical/Thermal Stimuli

This element includes the required optical and thermal stimuli sources to verify and calibrate the MODIS-N, including targets and special fixtures for these stimuli. It includes any optical and thermal sources needed to support the focus and alignment of the MODIS-N Aft Optics assemblies.

95AX GSE

This element includes the required optical and thermal stimuli sources to verify and calibrate the MODIS-N instrument, including sources, reticules, filters, and special sources for these stimuli. This equipment includes two calibrator assemblies, one for each STE unit, calibration blackbodies, space background simulators, stray light test sources, and special tooling and fixtures. Included is labor for calibration of the spherical integrating source. It includes optical design and fabrication support for focus and alignment fixtures required for the MODIS-N Aft Optics assemblies.

BXXX PRODUCT ASSURANCE & SAFETY

This element includes all the effort and analyses required to establish a set of requirements for the MODIS-N reliability and quality assurance program. This includes planning for the implementation of all efforts in the areas of reliability, quality assurance, system safety and parts programs.

B1XX Reliability & Safety Program

This element includes all effort, equipment, and material necessary to implement the reliability engineering and reliability assurance activities on the program. This includes each task in the MODIS-N Reliability Program Plan, such as: reliability engineering support to design, reliability engineering support to test, failure and malfunction reporting, cause and corrective action, stress analysis, worst case circuit analysis, radiation effects analysis, and support of design and readiness reviews. In addition are related documentation and reports not specified as deliverable items and preparation prior to "compilation" of deliverable items. This element also includes all effort, equipment, and material necessary to plan and implement a system safety program.

B1DX Reliability

This cost account includes all effort associated with the implementation of the Reliability Engineering and Assurance Program and the Safety Program.

As part of the Reliability Engineering and Assurance effort on MODIS-N, specific tasks will be performed. Program cost administration along with program supervision are planned. Design analysis tasks include a reliability mathematical

model and prediction, FMECA, worst case analysis, radiation analysis, and review of stress analysis. Program support activities will provide sustaining reliability to the program for status meetings, cost control, and interface with program personnel, review of drawings and specifications to assure parts, materials, and processes are on authorized lists; and attend change review board and parts, materials, and processes control board meetings, and provide program reliability functions for fabrication and test as well as provide reliability assessment for MRB and failure related problems.

This cost account includes the preparation of the following CDRL items: 206 (Component and Subassembly Test Reports for Subcontracted Items), 212 (Alerts), 213 (Responses to Alerts), 214 (Responses to NASA Problem Notices), and 507 (Critical Items list (CIL).

Reliability Engineering will coordinate and administer the Life Test Program as defined in the Performance Assurance Implementation Plan (paragraph 3.1.5.1 and 7.2.9).

The parts materials and process activities will provide part drawings for the various part types consisting of specification control and selected item drawings, review of data received with parts for accuracy and completeness, participation in PMPCB meetings and resolution of parts problems with vendors, and preparation and maintenance of the as-designed parts list.

The failure reporting and analysis effort will include failure reporting, investigations, and assurance of corrective action implementation. Review of overstress analyses to assure integrity of the flight hardware. Complete failure histories for major subsystems for review during consent to integrate meetings and failure analysis of components removed as a result of test failures.

The Reliability Engineering and Assurance activity will provide sustaining system safety engineering support for implementation and coordination of the system safety plan, including support to safety reviews; review of drawings, specifications, and test procedures; review and follow-up to ensure that identified hazards have been properly controlled; and provide program interface for SBRC Environmental Health and Safety Office; Accident Reporting & Investigation.

B2XX Quality Program

This element includes all effort, equipment, and material necessary to plan and implement the Quality Assurance program. This will include each task area delineated in the MODIS-N Quality Assurance Plan, such as government source inspection, quality assurance aspects of control of subcontractors, and fabrication controls. Also included are related documentation and reports not specified as deliverable items and preparation prior to "compilation" of deliverable items.

B2CX Quality

This cost account includes all effort, equipment, and material necessary to plan and implement the Quality Assurance program. It includes all efforts required by the Quality Organization in support of the Performance Assurance Implementation Plan requirements and SBRC Quality Practices. It includes preparation of CDRL items 205 (Audit Reports), 210 (MRB Decisions on Non-conformance), 501 (Audit

program Description), 526 (Acceptance Data package), and 530 (Material Inspection ADN Receiving Report). It includes the following:

(1) Administrative efforts required to perform project cost budgeting, analysis, variances identification, resolution and reporting. This effort includes supervision and the audits of internal quality, PAIP system/disciplines and certified personnel.

(2) Quality Engineering efforts required to perform initial quality planing, project management, drawing and work instruction reviews, generation of receiving/in-process inspection procedures, supplier surveys, procurement document reviews, resolution of non-conforming material, review of Engineering Changes/parts control selection, auditing of processes/ hardware and the monitoring of assembly integration and testing operations.

(3) Production Test Engineering efforts required to monitor test set prove-in, approved test and calibration procedures for STE, audit STE workmanship, generate and implement software assurance plan that ensures compliance to applicable software protocols through audits, inspection and surveillance techniques.

(4) Supplier Quality efforts required to ensure the selection of qualified suppliers, receiving/source inspection of hardware, surveillance/audits of critical suppliers, tracking and identification of parts, proper handling of complex/static sensitive parts, maintenance of receiving records including supplier/part performance.

(5) In-process Inspection efforts required to audit manufacturing planning and the performance of manufacturing fabrication operations, kit inspection, tracking/identification and configuration verification, 100% inspection of non-standard focal-plane array fabrication and audits of personnel/ equipment certification as appropriate.

CXXX PRE-& POST-LAUNCH SUPPORT

C1XX Pre- & Post-Launch Support

This element includes the effort' required to support the MODISH program from the integration of each MODIS-N instrument into an EOS spacecraft through the analysis of its integration into the spacecraft through the analysis of its initial output data, video and telemetry, during its first three months in orbit. This support is anticipated to last twenty-one months pre-launch and three months post-launch for each flyable model.

This element includes the effort associated with field engineering support, as well as support at the SBRC facility (special tests, data analysis), to integrate and test each flyable MODIS-N model with the spacecraft at the spacecraft contractor's facility and at the launch site. It includes support for cross calibration of instruments at the spacecraft contractor's facility.

This element covers the effort associated with the engineering and other efforts as required, to support launch operations for each flyable MODIS-N model.

This element includes the effort associated with supporting the required Post-launch activities, including the analysis and evaluation of data and telemetry from each MODIS-

N model during the first three months of operation in order to determine and compare its performance with the requirements of the specification

C10X Program Office

This cost account includes all activities to support pre-launch and post-launch functions.

DXXX FLIGHT MODEL 2

D1XX Optical Assemblies and Mounts

This element includes the development, fabrication, and verification of the Flight Model 2 Afocal Telescope Assembly, and the aft-optics objective assemblies (VIS Objective, NIR Objective, SWIR/MWIR Objective, and LWIR Objective), the dichroic beamsplitters (Dichroic #1, Dichroic #2, and Dichroic #3) and their mounts, and the spectral filters for the VIS, NIR, SWIR/MWIR, and LWIR focal planes. The fabrication of the Optical Bench Housing is included in this element. The fabrication of the filter mounting hardware is included in element D2XX. This element includes the generation and the maintenance of required engineering drawings, assembly planning and support, manufacturing assembly, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of component integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for these optical assemblies and mounts. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for D14X and D15X cost accounts.

D14X Mechanics

This cost account is equivalent to 614X.

D15X Optics

This cost account is equivalent to 615X.

D1BX Manufacturing

This cost account is equivalent to 61BX.

D2XX Focal Plane Assemblies

This element includes the development, fabrication, and verification of the Flight Model 2 Focal Plane Assemblies (FPAs). It includes the complete fabrication of the VIS Focal Plane Assembly, NIR Focal Plane Assembly, and the Cold Focal Plane Assembly (CFPA), except for the spectral filters which will be provided under WBS-element D1XX and the CFPA platform (dewar stem) which will be provided under WBS-element D5XX. This element includes the generation and the maintenance of required engineering drawings, manufacture planning and scheduling, manufacturing assembly, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of component integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for these focal plane assemblies. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes the effort associated with providing technical and programmatic direction to the Hughes Technology Center and coordinating the fabrication and delivery of the VIS and NIR sensor chip assemblies and all focal plane readout circuits. It includes cost and schedule planning, control, and statusing for D2XX cost accounts.

D28X Focal Planes
This cost account is equivalent to 628X.
D2FX HTC
This cost account is equivalent to 62FX.

D3XX Mainframe Structure and Doors

This element includes the fabrication and testing of the Flight Model 2 mainframe structure and the system aperture, solar calibration, and radiative cooler anti-contamination door assemblies. The fabrication of actuators to control these doors and fabrication of the multi-layer insulation (MLI) thermal blankets are also included in this element. This element includes the generation and the maintenance of required engineering drawings, assembly planning and support, manufacturing assembly, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of component integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the mainframe structure, doors, and MLI thermal blankets. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for all D34X cost accounts.

D34X Mechanics
This cost account is equivalent to 634X.
D3BX Manufacturing
This cost account includes the same tasks as 63BX.

D4XX Scan Mirror Assembly

This element includes the fabrication and testing of the Flight Model 2 scan mirror subsystem, except for the control electronics which are included in element D6XX. This element includes the fabrication and testing of the two-sided scan mirror, low distortion mirror mount, and the scan mirror and coatings, and the motor mount assembly. This element includes the generation and the maintenance of required engineering drawings, assembly planning and support, manufacturing assembly, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of part integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the two-sided scan mirror, low distortion mirror mount, the scan mirror and coatings, and the motor mount assembly.. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for all D44X and D45X cost accounts.

D44X Mechanics
This cost account is equivalent to 644X.
D45X Optics
This cost account is equivalent to 645X.
D4BX Manufacturing
This cost account is equivalent to 64BX.

D5XX Radiative Cooler Assembly

This element includes the fabrication and testing of the Radiative Cooler. This element does not include the fabrication and testing of the Cold Focal Plane Assembly, but does

include the fabrication of the dewar stem which is incorporated as part of the CFPA prior to installation of the CFPA into the Radiative Cooler. This element includes the generation and the maintenance of required engineering drawings, assembly planning and support, manufacturing assembly, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of component integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the Radiative Cooler. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for all D54X cost accounts.

D54X Mechanics
This cost account is equivalent to 654X.

D5BX Manufacturing
This cost account is equivalent to 65BX.

D6XX Main Electronics Module

This element includes the fabrication and testing of the Flight Model 2 Main Electronics Module, including the fabrication of any harnesses that may be necessary to interconnect the Main Electronics Module with the Analog Electronics Modules, the On-Board Calibrators, and other elements of the electrical subsystem. This element includes the generation and the maintenance of required engineering drawings, assembly planning and support, technical vendor surveillance and procurement support, manufacturing assembly, preparation of test procedures, testing during fabrication and alignment, conduct of component and assembly integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the Main Electronics Module. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for all D66X, D6GX, and D6HX cost accounts.

D66X Electronics
This cost account is equivalent to 666X.

D6BX Manufacturing
This cost account includes the same tasks as 66BX.

D6GX EDD
This cost account is equivalent to 66GX.

D6HX Electronics Packaging
This cost account is equivalent to 66HX.

D7XX Analog Electronics Modules

This element includes the fabrication and testing of the Flight Model 2 Analog Electronics Modules. This element includes the generation and the maintenance of required engineering drawings, assembly planning and support, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of component and assembly integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the Analog Electronics Modules. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes

cost and schedule planning, control, and statusing for all D76X and D7HX cost accounts.

D76X Electronics
This cost account is equivalent to 676X.
D7BX Manufacturing
This cost account is equivalent to 678X.
D7HX Electronics Packaging
This cost account is equivalent to 67HX.

D8XX On-Board Calibrators

This element includes the fabrication and testing of the Flight Model 2 On-Board Calibrators, including the Blackbody, the Solar Diffuser, the Solar Diffuser Stability Monitor, and the Spectroradiometric Calibrator. It includes the generation and the maintenance of required engineering drawings, assembly planning and support, technical vendor surveillance and procurement support, preparation of test procedures, testing during fabrication and alignment, conduct of component and assembly integration and performance tests, test data reduction and analysis, and preparation of reports and special analyses for the On-Board Calibrators. This element includes the cost of materials and subcontracts as well as the generation of special test procedures and the purchase and/or fabrication of special fixtures and test equipment related to this task. It includes cost and schedule planning, control, and statusing for all D84X, D85X, and D86X cost accounts.

D84X Mechanics
This cost account is equivalent to 684X.
D85X Optics
This cost account is equivalent to 685X.
D86X Electronics
This cost account is equivalent to 686X.
D8BX Manufacturing
This cost account is equivalent to 68BX.

D9XX Integration, Test & Calibration

This element includes the integration of all components/assemblies into a complete MODIS-N Flight Model and its test and calibration. It includes integration, final assembly, system-level alignment, inspection check lists, conduct of performance and environmental tests, instrument calibration, mass property measurement, compatibility tests, test data collection, reduction and analyses and issuance of test reports. This element includes the generation and the maintenance of required engineering drawings, assembly planning and support, technical vendor surveillance and procurement support. This element includes the cost of materials and subcontracts required to support the System Integration, Test, & Calibration activity that are not covered elsewhere in the WBS. It includes, for the period beginning with the delivery of Flight Model 1 to delivery of the Flight Model 2, all effort to sustain, maintain, and periodically calibrate the Ground Support Equipment, including any maintenance contracts for commercial equipment and software. It includes cost and schedule planning, control, and statusing for all D9EX cost accounts.

D9BX Manufacturing
This cost account is equivalent to 69BX.
D9EX System Test
This cost account is equivalent to 79EX.

DAXX On-Board Software Maintenance

This .element includes the maintenance of all on-board software.

DA6X Electronics

Same as DAXX.

DDXX Storage & Storage Test

This element includes the effort, equipment, materials and verification necessary to store the completed Flight Model 2 until the time for integration on a spacecraft. It includes storage environment requirements, scheduled storage testing and evaluation, and a complete post-storage/pre-integration test and calibration sequence.

DDEX System Test

Same as DDXX.